MACHINERY

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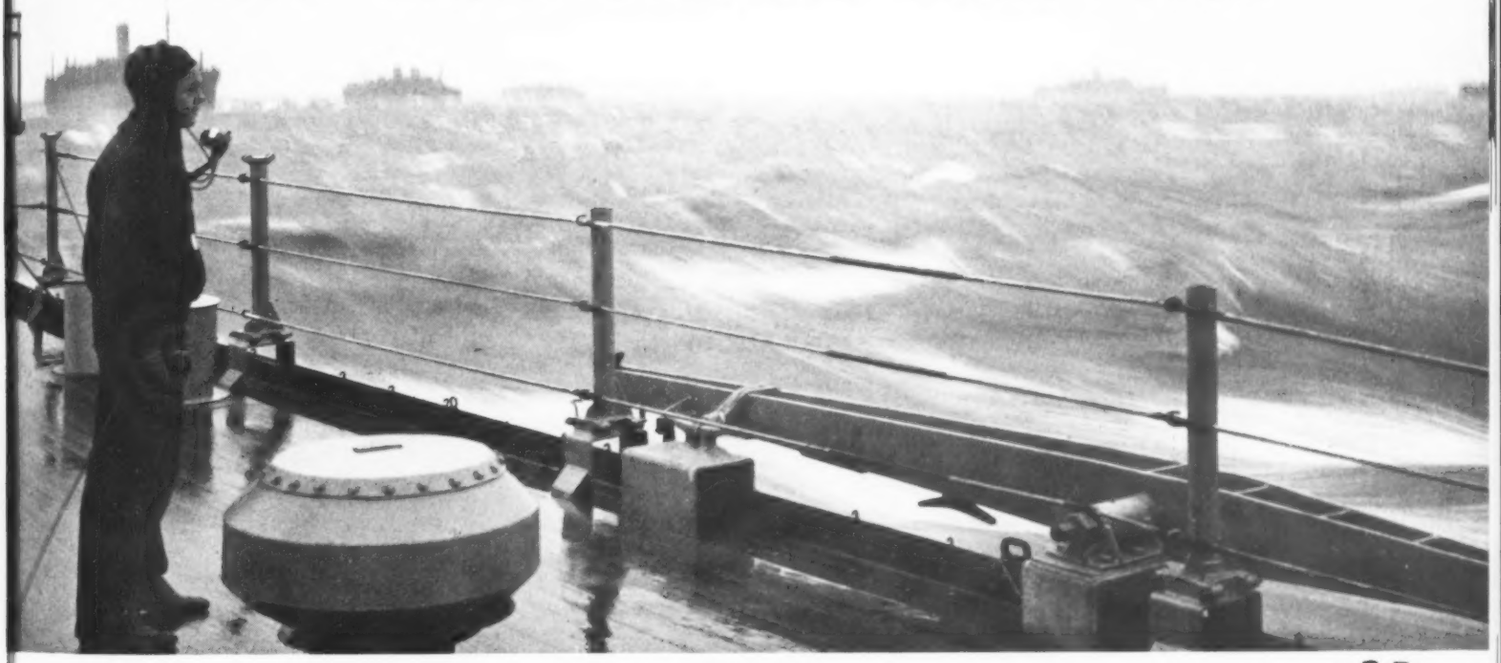
Guns to Arm Our Merchant Marine



Twenty-Millimeter Anti-Aircraft Guns for Our Merchant Vessels are Being Produced by Quantity Manufacturing Methods in a Plant Set up by the Pontiac Motor Division of the General Motors Corporation

By CHARLES O. HERB

FREEDOM of the seas—one of our most cherished traditions since the very founding of the United States—will once more be backed up by the arming of our merchant vessels. They are already being equipped with a rapid-fire 20-millimeter anti-aircraft gun which has proved especially effective in combatting dive bombers. This gun is capable of firing over 450 explosive shells a minute.

Last spring a contract for the production of these guns was awarded to the Pontiac Motor Division of the General Motors Corporation at a time when the drawings were still incomplete. However, a sample gun was on hand. A special engineering department was immediately set up for this class of work which, incidentally, has slight similarity to automotive production. As a matter of fact, of the several hundred ma-

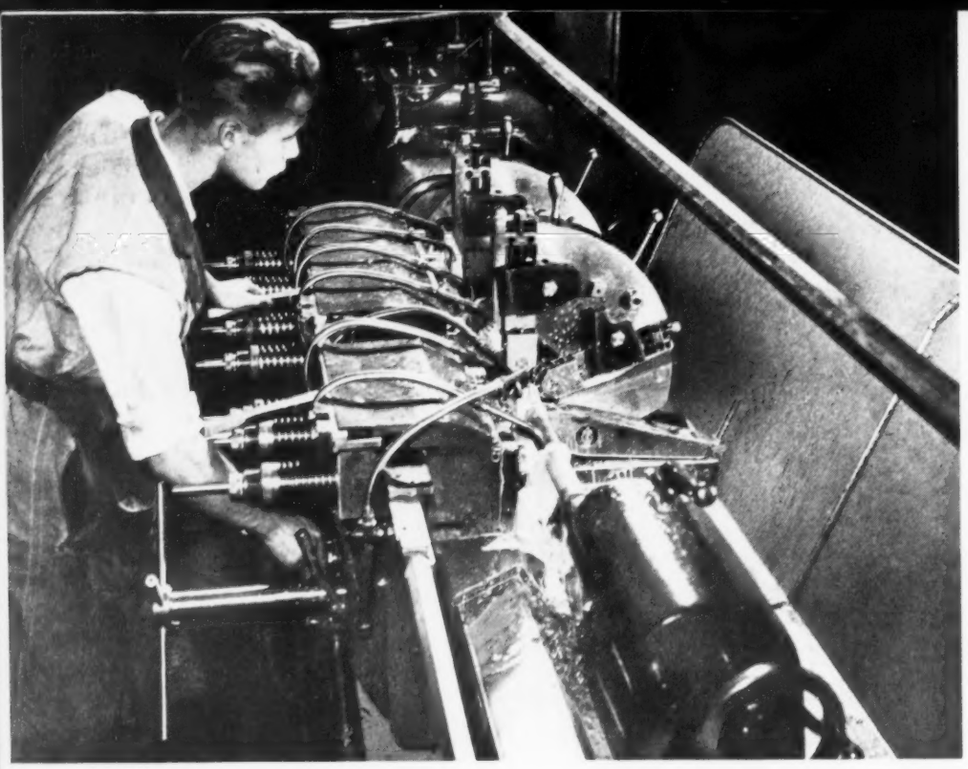
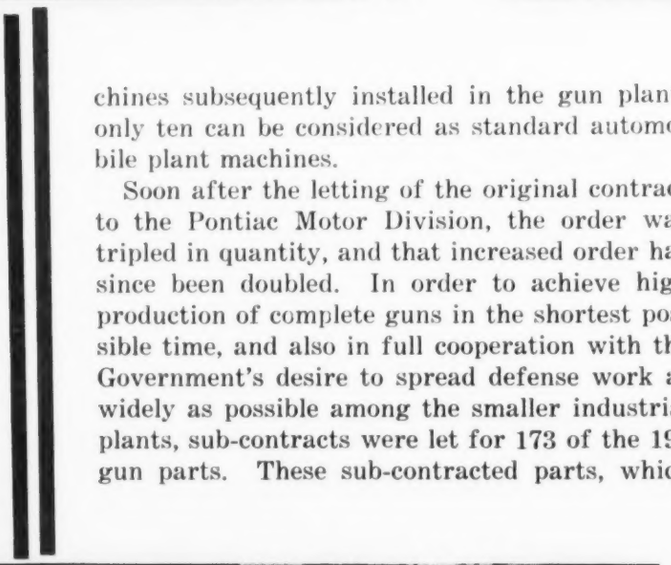


Fig. 1. Multiple Turning Operation on a Machine Provided with a Profile Bar that Imparts In and Out Movements to the Tools



chines subsequently installed in the gun plant, only ten can be considered as standard automobile plant machines.

Soon after the letting of the original contract to the Pontiac Motor Division, the order was tripled in quantity, and that increased order has since been doubled. In order to achieve high production of complete guns in the shortest possible time, and also in full cooperation with the Government's desire to spread defense work as widely as possible among the smaller industrial plants, sub-contracts were let for 173 of the 195 gun parts. These sub-contracted parts, which include the entire gun mount, are being made in shops from Maine to Wisconsin. They are sent to the Pontiac plant for assembly into complete guns. The most difficult parts, such as the breech casing, the barrel, and the trigger casing are manufactured in the Pontiac plant. Outstanding operations in making these parts are described in this article.

Two points of engineering interest stand out in the manufacture of the gun parts—first, the high degree of accuracy to which practically every piece must be machined; second, the great amount of stock that must be removed from the original forgings in order to obtain the finished designs. Tolerances are generally only a few ten-thousandths of an inch. So far as stock removal is concerned, it may be pointed out that the breech-case forging weighs 170 pounds, and the finished casing only 41 pounds; the forging for the trigger casing weighs 22 pounds, and the finished casing 4 1/2 pounds; and the forging for the recoil spring case weighs 56 pounds, while the finished case weighs only 6 pounds. In the last example, only a little more than 10 per cent of the original material remains in the finished part. Two hundred and fifty operations are required to finish the breech casing alone. Taking the shop as a whole, it is safe to say that 85 per cent of all operations are performed on some type of milling machine.

Fig. 2. Two Hobbing Machines which Cut Cooling Fins for a Length of 24 Inches along the Outside of the Gun Barrels

Fig. 3. One of Several Operations Performed on Cylindrical Grinding Machines to Bring External Surfaces to Specified Diameters

In preparing for the machining of the gun barrels, two spots are first ground on the forgings to provide steadyrest support while rough-turning, and the breech end is turned to permit holding it in a chuck. The rough-turning operation is performed on the Lo-swing lathe illustrated in Fig. 1, which is equipped with seven tools on two carriages at the front of the bed. A profile or cam bar attached to the bed extends through both carriages, and all seven tool-blocks are held against this bar by spring tension. As the carriages are fed along the bed, the tool-blocks are moved in and out in accordance with the contour of the profile bar, so that the tools machine the barrel to the required diameters and tapers.

The limits on this operation are plus or minus 0.004 inch, stock being removed to depths of from 1/8 to 1/4 inch. Two similar machines finish the barrels—one the breech end and the other the muzzle end.

After the muzzle has been finish-turned, the barrels are routed to a Cleveland Rigidhobber for machining eight cooling fins or splines for a length of about 24 inches. The grooves are cut to a depth of 5/8 inch, there being a tolerance of plus or minus 0.005 inch on the depth. This hobbing machine is shown in Figs. 2 and 4.

The climb-milling principle is employed in this operation—that is, the hob is revolved in a direction opposite to that in which it usually rotates. When conventional rotation was employed, the cutter failed to "stand up" under the severe strain imposed. In operation, the cutter-heads remain in one position, and the work is fed up past the hob hydraulically. The barrel is held between chucks, and supported by three steadyrests in order to insure steady rotation over its full length of 60 inches.

After a rough-grinding operation on three diameters, the barrels go to a Pratt & Whitney duplex gun drilling machine, such as shown in Fig. 6. This operation is of the utmost impor-

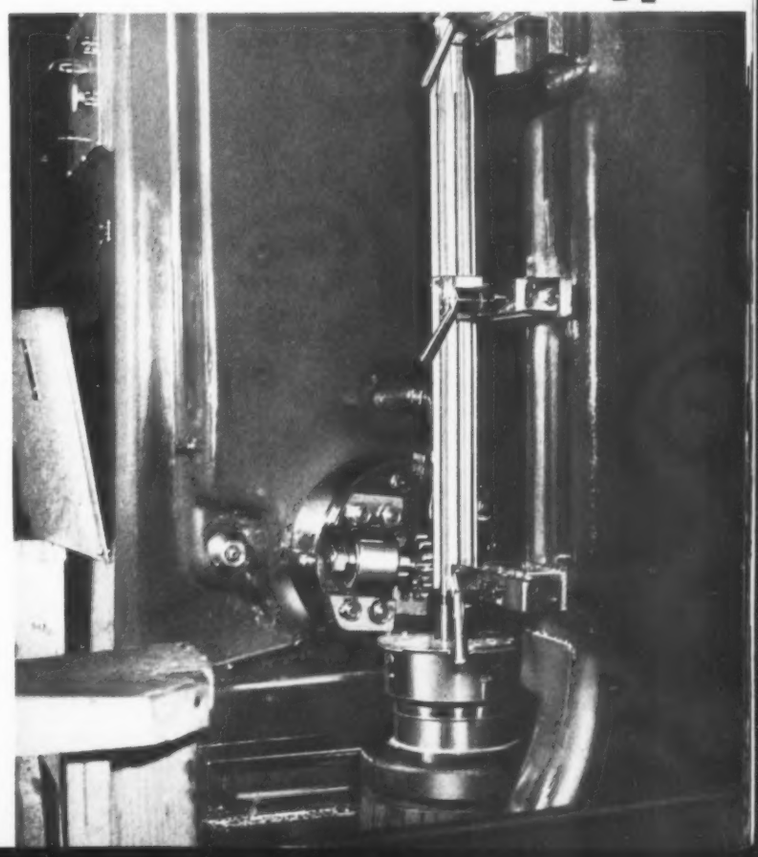


Fig. 4. Close-up View of One of the Hobbing Operations that Produces the Barrel Cooling Fins

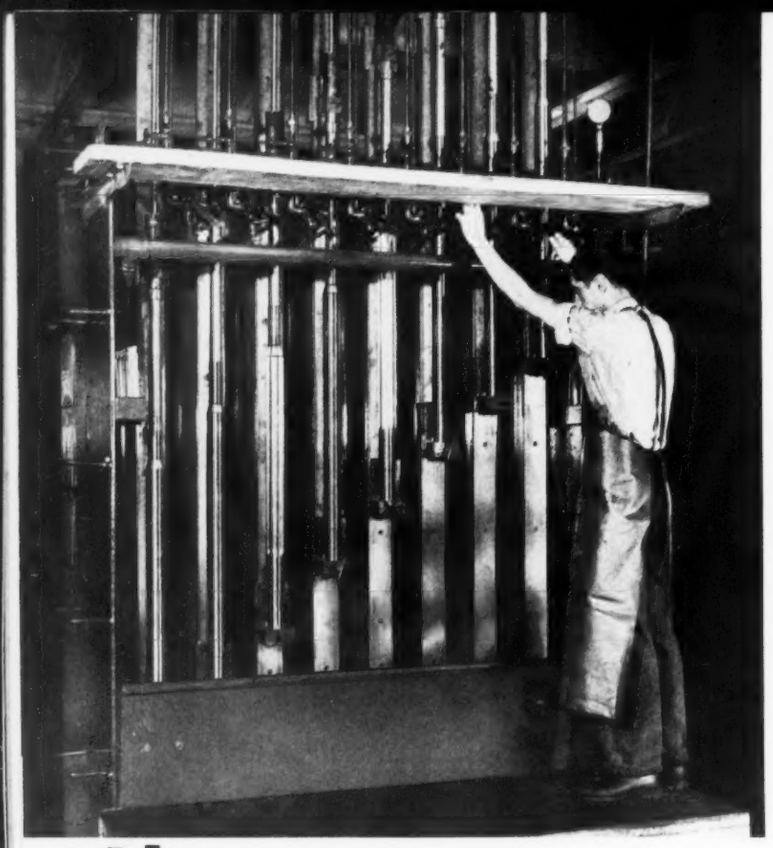


Fig. 5. Eight-spindle Machine which Performs Three Reaming Operations on the Barrel Bore

tance, because the concentricity and straightness of the finished barrel depends to a large extent upon the accuracy of the drilling. Conventional single-flute gun drills are employed. An oil-gallery hole which extends through the drill to the front end, enables coolant under high pressure to reach the cutting lip of the drill and thus wash all chips back along the drill flute and out of the barrel.

The drill cuts to a diameter of 0.760 inch. On successive barrels, the diameter variation is not more than 0.004 inch, and reaming operations take care of that. Three reaming cuts are taken in each barrel bore, approximately 0.012 inch of stock on the diameter being removed in the first cut, 0.008 inch in the second, and 0.006 inch in the third.

All reaming cuts are taken on the Flannery machine shown in Fig. 5, which is designed with eight reamer heads and work-slides. The gun barrels are mounted on the slides, and traversed quickly over the reamer spindles to their highest position under hydraulic action. The reamers are then attached to their spindles.

When the operation is started, the slides move downward by gravity, being retarded somewhat in their descent by oil cylinders, which provide the slow feed consistent with a fine finish. When the barrels leave this machine, the bore is to size within plus or minus 0.001 inch and straight within 0.0003 inch. Although hydraulic presses were installed for the purpose of straightening the barrels, it has not yet been necessary to do this, except on an occasional barrel. The eight units can be operated individually or together.

A bore diameter of 20 millimeters and a high degree of finish are finally obtained by honing in the horizontal Barnes machine shown in

Fig. 6. Duplex Drilling Machine which Performs the First Operation on the Barrel Bore so Accurately that no Straightening is Necessary

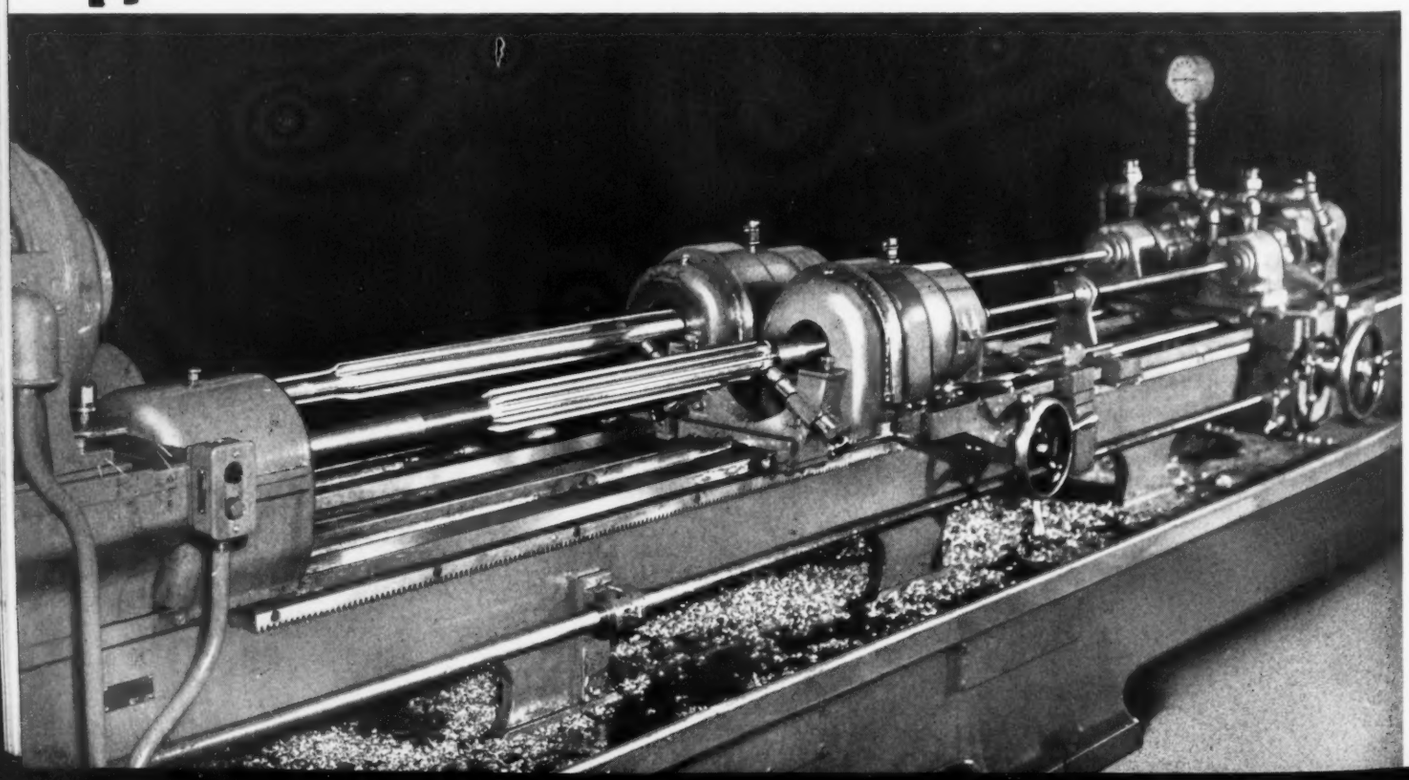


Fig. 7. Engraving the Required Markings on the Gun Barrel with a Pantograph Type Engraving Machine

Fig. 10. About 0.006 inch of stock on the diameter is removed in this operation. After it has been performed, the straightness of the bore is checked by passing through it an 8-inch long plug that is only 0.0002 inch smaller in diameter than the minimum bore size. The tolerance allowed on the barrel bore is plus or minus 0.0005 inch.

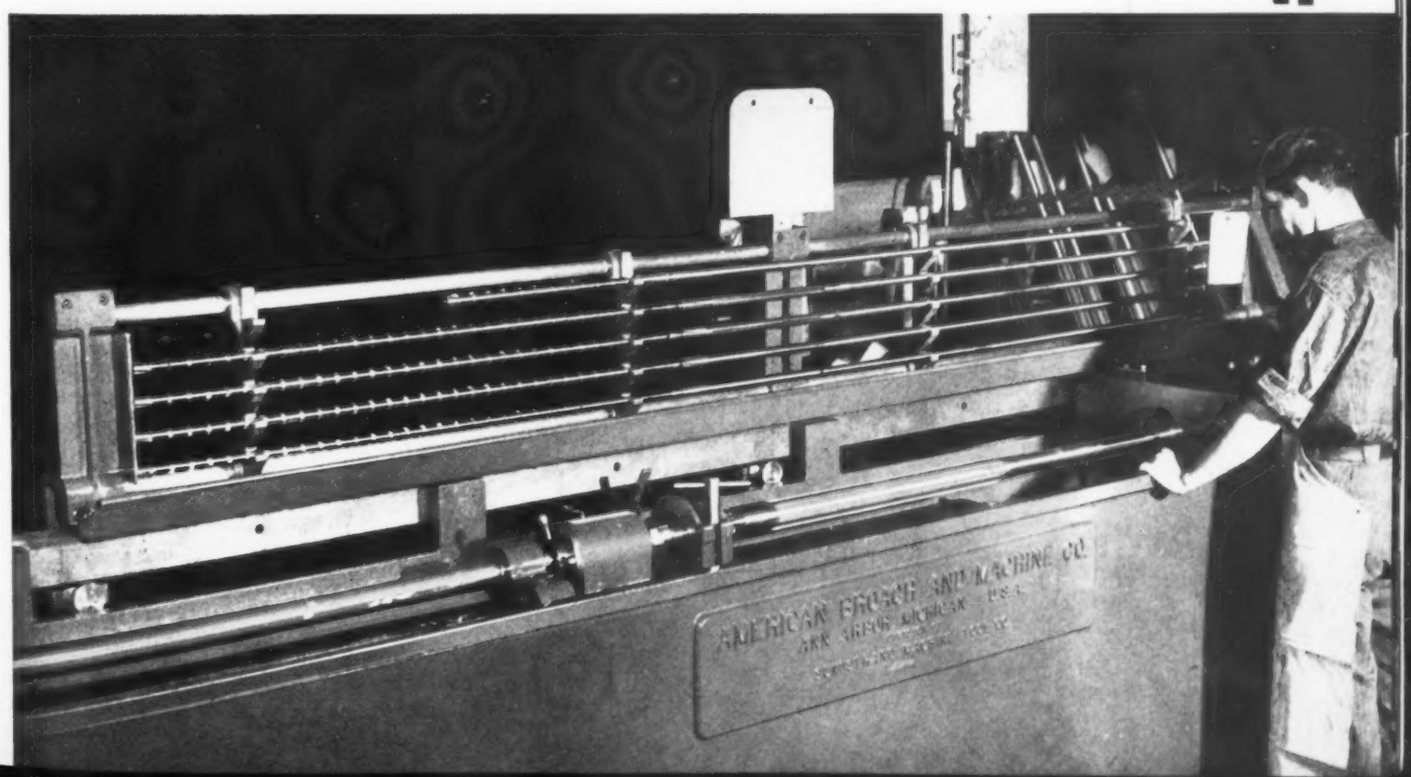
External surfaces are finish-ground on Landis cylindrical grinding machines after boring, as shown in Fig. 3. Such diameters are held within tolerances of 0.0007 inch on the breech end and 0.0047 inch over the cooling fins.

The adoption of the broaching process for rifling the barrels has reduced the rifling time from 1 3/4 hours by the former method to only ten minutes. A general view of the American broaching machine employed for this operation is shown in Fig. 8. Five broaches which machine all nine grooves at a time are used in succession. The first broach cuts a narrow groove to almost the full depth; the second and third broaches cut to the same depth but to greater widths; and the fourth broach cuts to the finished depth and width. The fifth broach is used in some instances as a sizing broach.

In operation, each barrel is clamped between the faceplate of the machine and a tailstock. Then the first broach is slipped through the barrel and automatically connected to the pull-head of the machine. A long tube on a slide at the left is then advanced to the tailstock over the broach. This tube remains against the end of the barrel throughout the operation and confines the cutting lubricant, which is delivered to the broach teeth at high pressure.

The broach rack seen at the rear of the machine travels back and forth with the broach

Fig. 8. The Rifling Grooves are Broached in the Gun Bore by the Use of Four or Five Broaches; the Broach Rack Reciprocates with the Ram



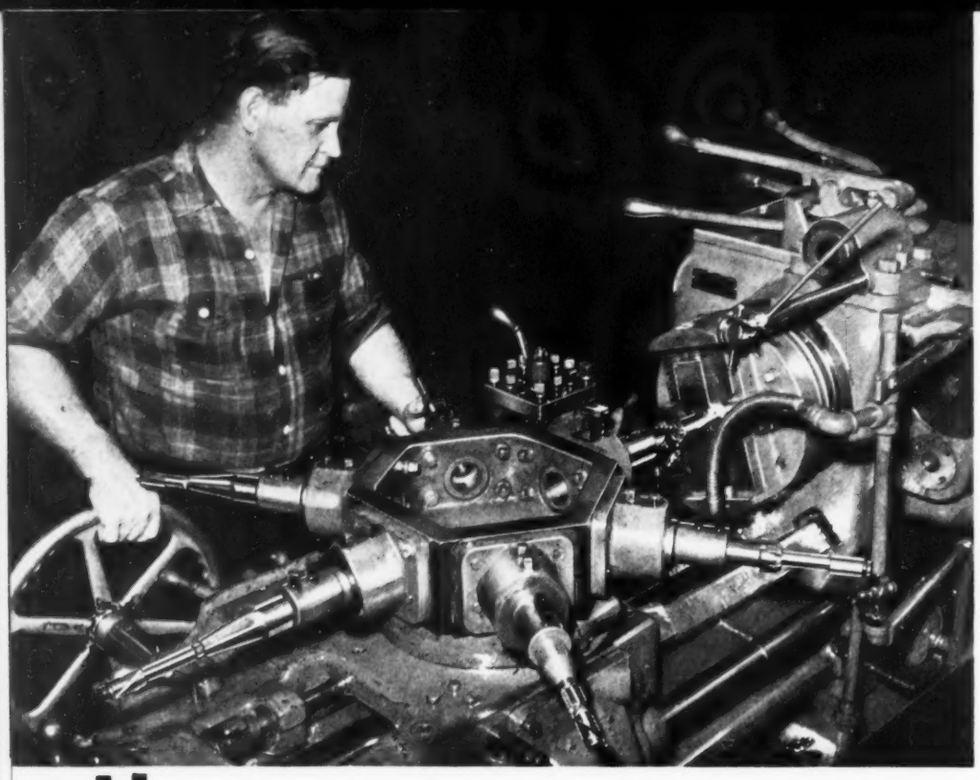


Fig. 9. (Left) The Various Chambering Operations on the Breech End of the Barrel are Performed on a Turret Lathe

Fig. 10. (Below) All Barrels are Honed so Accurately that a Plug 8 Inches Long and Only 0.0002 Inch Smaller than Low Limit of the Bore Can be Passed through it

ram. Thus when the end of a broaching stroke is reached, the operator disconnects the broach from the pull-head and places it in its proper position on the rack. The rack then returns to its starting location, whereupon the operator selects the next broach and places it in the work for the succeeding cut.

The riflng grooves are cut to a constant lead, which is controlled by a lead-screw that swivels the broach as it moves through the work. The grooves are cut for a length of approximately 4 feet. The depth of 0.016 inch must be held to size within plus 0.0039 inch, minus nothing, while the width must be held to limits of plus 0.0118 inch, minus nothing.

The various chambering cuts on the breech end of the barrel are performed on Warner & Swasey turret lathes set up as illustrated in Fig. 9. All cuts in the chamber are taken by tools mounted on the hexagon turret, and it will be noted that each of the tool-bars is provided with a live pilot that registers in the gun bore. The gun barrels are loaded into the machine spindle from the far end of the headstock.

The interrupted annular locking grooves are cut externally on the breech end of the barrel in an American lathe tooled up as shown in Fig. 11. Two blocks at the front and rear of the cross-slide are fitted with four tools each. The front tools are first fed to the work for

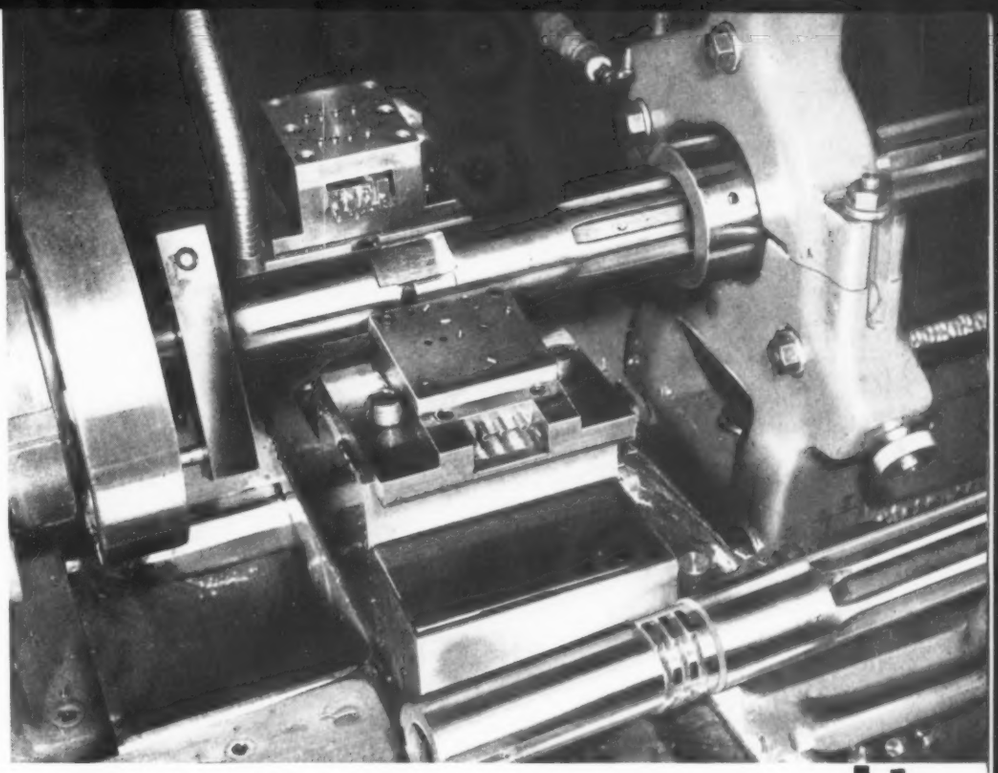


Fig. 11. (Right) Engine Lathe Set-up for Cutting the Interrupted Annular Locking Grooves on Breech End of Barrel

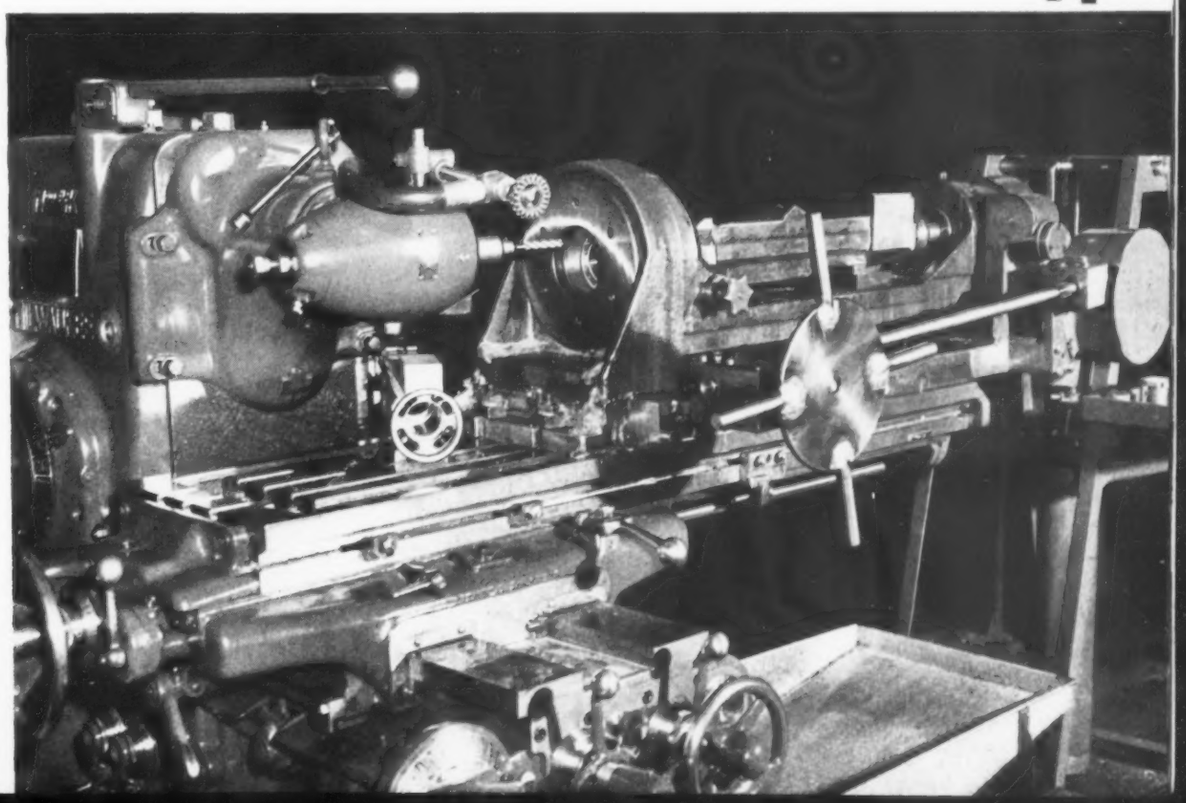
Fig. 12. (Below) Milling Operation on the Breech Casing Performed on a Machine Equipped with an Ingenious Fixture for Indexing and Revolving the Work-piece

roughing out the stock to form the solid rings, and then the rear tools are advanced for taking finish cuts. Previous to this operation, depressions have been milled at three points around the barrel so as to obtain interrupted rings. To provide a support close to the cutting tools, a sleeve is slipped over the cooling fins of the gun barrel before it is placed in the machine. This provides a cylindrical contacting surface in the steadyrest.

Accuracy is of paramount importance in the spacing of the annular rings. The distance from each ring to its common locating point and the spacing of all rings with respect to each other are held within 0.0008 inch. The width of the rings is 0.236 inch, and the depth of the grooves between them 0.200 inch.

The ends of the annular locking rings are rounded by means of the simple Flannery machine shown in Fig. 13, which utilizes a single-point tool ground flat on one side like an engraving cutter. This tool is held in a spindle that is positioned at an angle on an arm which is readily swung around the stationary column of the machine by merely pulling on a lever. In this way, the cutter is fed 180 degrees around the end of each ring.

Accurate location of the barrel for rounding the rings is insured by the use of a spacing sleeve which is mounted on the right-hand end



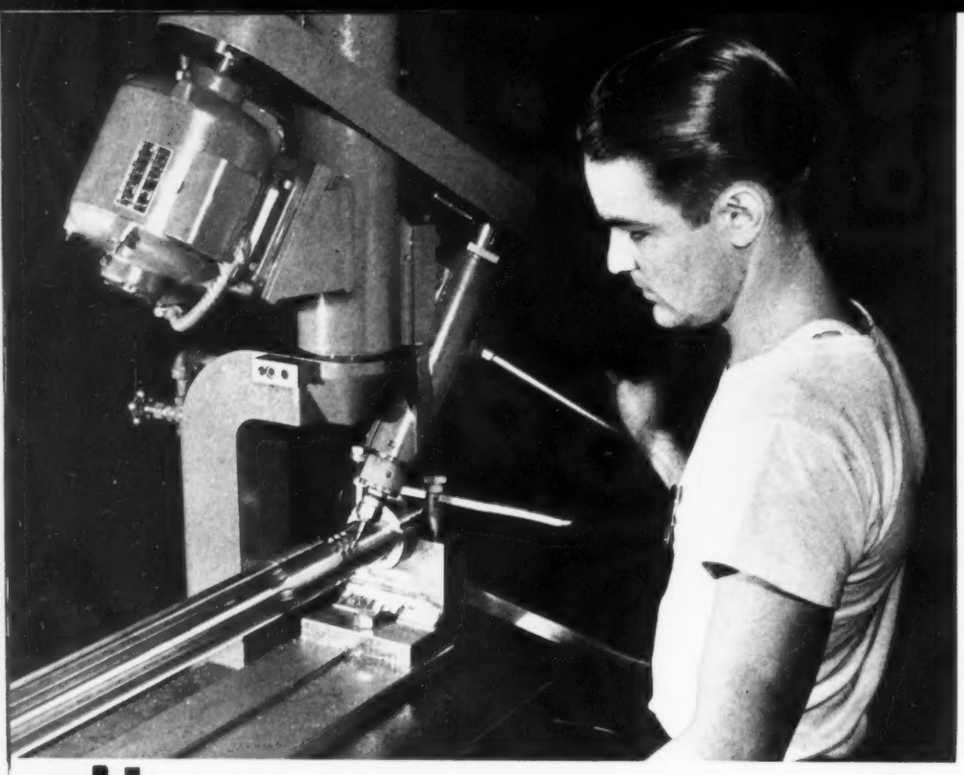


Fig. 13. Simple Type of Machine Devised for Rounding the Ends of the Annular Locking Rings on the Gun Barrel

of the barrel, as seen in the illustration. There are three sets of holes of three each around the spacing sleeve and these holes are successively engaged by a dowel-pin that projects upward from the half-bearing in which the sleeve is seated. Accurate radial location of the sleeve on the barrel is obtained by registering a projection on the barrel in a keyway in the sleeve bore. The long lever on the fixture facilitates lifting the sleeve and barrel in indexing from hole to hole of the sleeve.

Final delicate hand grinding operations on the breech end of the barrels are performed by the use of Black & Decker high-speed portable electric grinders. They run at a speed of 19,000 R.P.M. Two operators doing this kind of work are seen in Fig. 15 at a bench cut to an irregular contour for the convenience of the men. "Pencil Point" grinding wheels are employed.

The words "Insert" and "Lock," identifying symbols, etc., are engraved in small letters on the gun barrel by the use of a Gorton engraving machine, the barrel being held in a fixture on the machine table, as seen in Fig. 7. The cutter is guided over the work, as in conventional operations on machines of this type, by pantograph arms while the operator moves a tracer over a brass templet held on a platen at the top of the machine. Machines of the same type are used for engraving the required markings on the breech casings.

Tooling up for the production of the breech casing presented numerous problems because of the intricacy of the finished piece, the close tol-

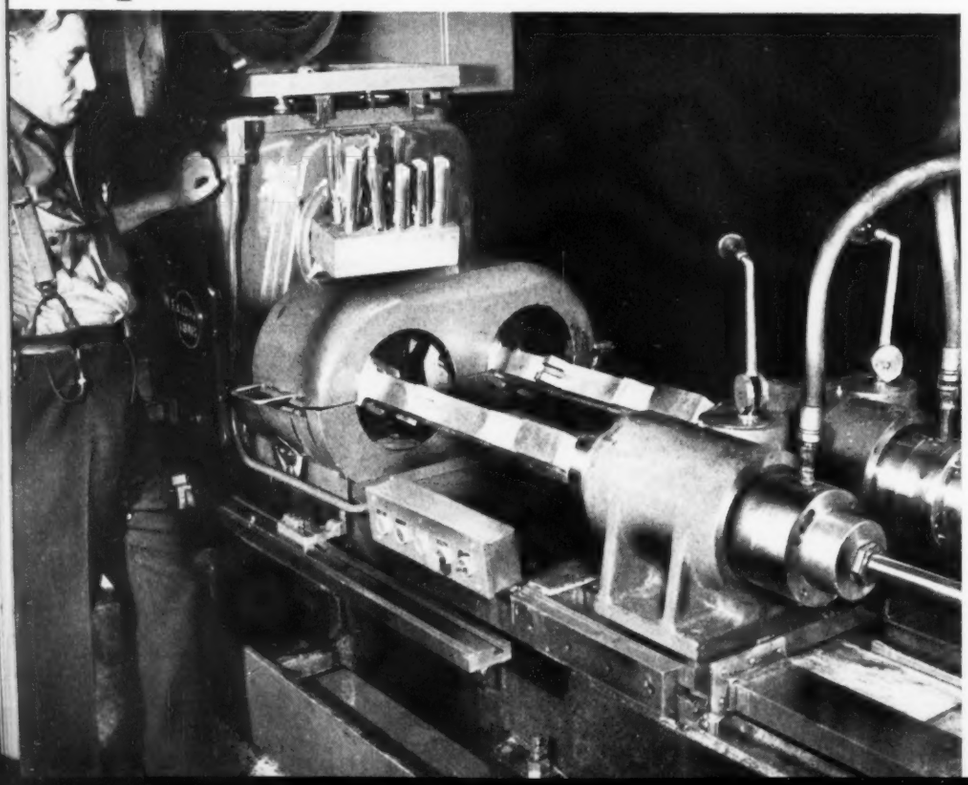


Fig. 14. Machine Used for Drilling 1 1/2-inch Holes in Two Breech Casings through 36 Inches of Solid Metal

Fig. 15. Grinding Operations being Performed on the Gun Barrels by Portable High-speed Electric Tools

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erances specified, and the great amount of stock to be removed from the tough material. The casing is made of S A E 4340 steel, and all of the finishing cuts are taken after the part has been hardened and tempered to a Brinell hardness reading of 320. In the annealed state in which the casings are roughed, they have a hardness of about 246 Brinell.

After preliminary milling and surface grinding operations, the breech casings reach the W. F. & John Barnes duplex machine shown in Fig. 14, which drills a 1 1/2-inch diameter hole through 36 inches of solid metal in two casings simultaneously. For this operation, the work is held securely between headstock chucks and adapters on a bed slide, the adapters being ground externally to a taper so as to insure accurate seating of the breech casing ends. The adapters are advanced against the work and clamped there by the operation of the vertical levers on the slide.

The drill spindles are mounted in holders carried on the bed slide and are connected to tubes that extend to the right-hand end of the bed. The drills are of a two-flute design, as seen in the box at the front of the headstock, and are made with hollow shanks which enable all chips to be washed from the cutting edge back through the tube to which the drill shank is connected. Oil is fed to the cutting edge of each drill around the outside of the tool. The cutting edges are ground with chip breakers so that fine chips will be produced that can be disposed of through the drills and their tubes. Only the work-pieces

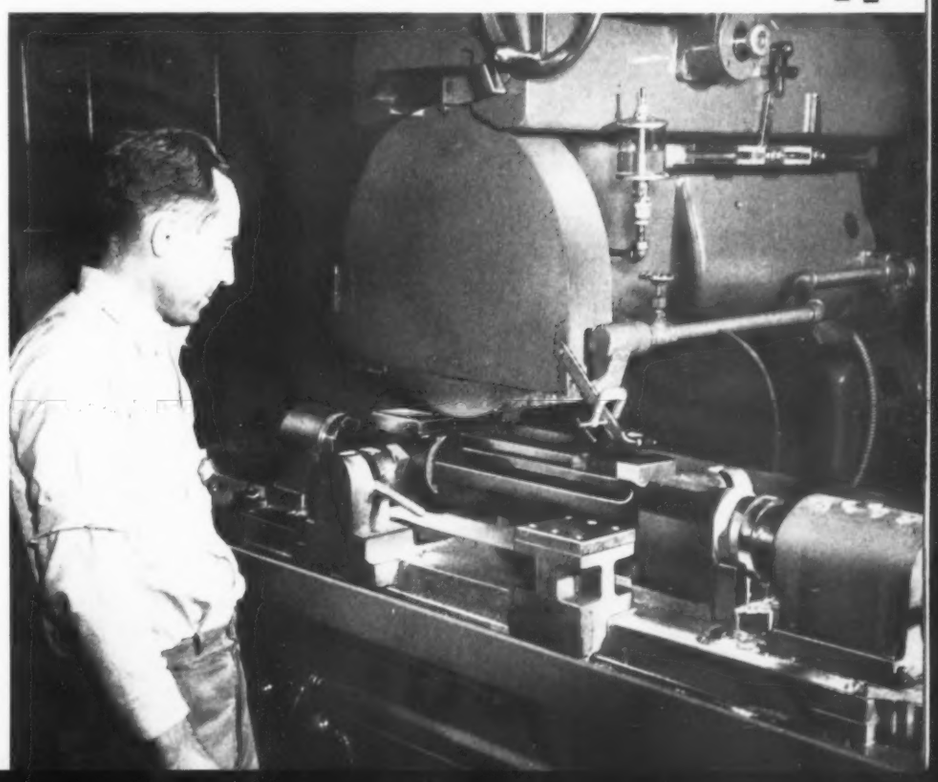

Fig. 16. Surface Grinding Operation in which Feet on the Breech Casing are Ground within Limits of 0.0005 Inch

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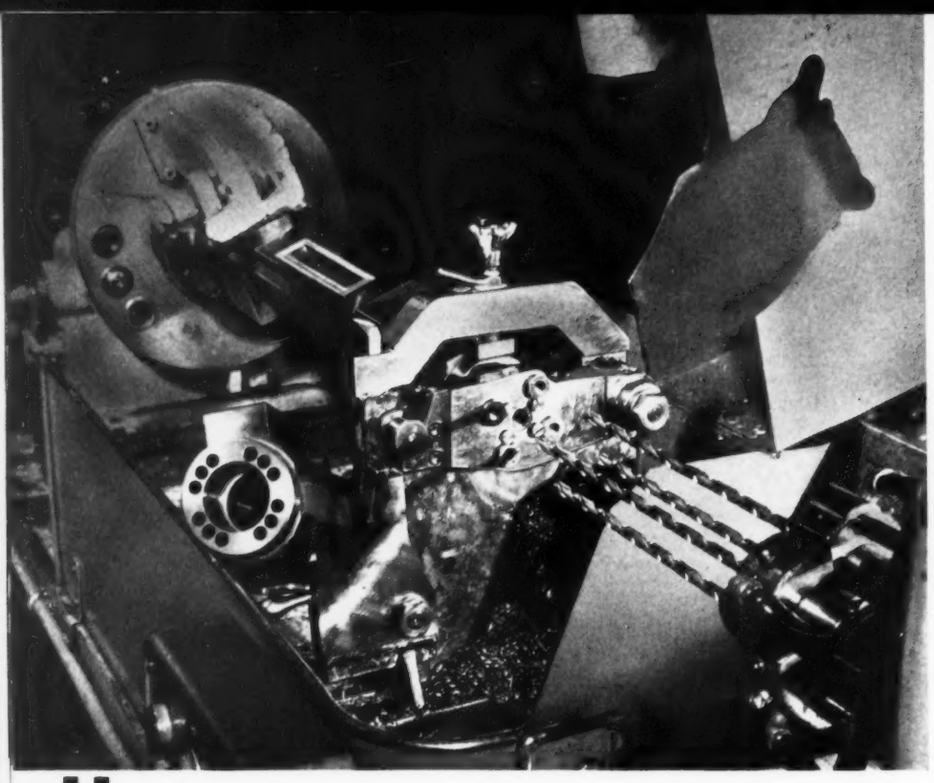


Fig. 17. (Left) Holes are Drilled to a Depth of 10 1/2 Inches with a 1/16-inch Wall between Them

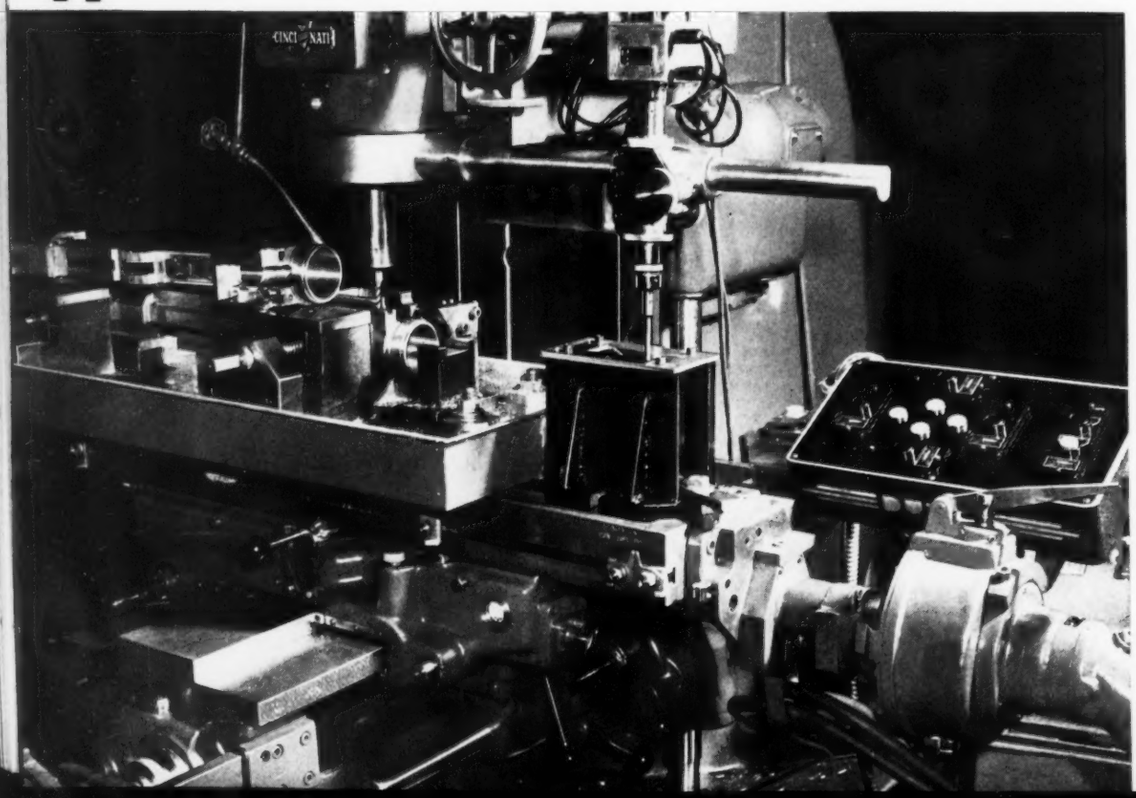
Fig. 18. (Below) Profile Milling Operation on the Breech Casing Performed on a Machine Equipped with a Duplicator that Controls the Table and the Carriage Movements

revolve in this operation; the drills are fed into the work by hydraulic power. Drill tips 6 inches long are used.

When the casings have been heat-treated, they are bored in a similar machine by employing a 2-inch core drill which is fed to a depth of 25 inches. Later on the casings are line-bored, and finally finish-bored by carbide blades inserted in a boring-bar that is supported by half shoes of babbitt, which are turned to the same diameter as the cutting tools. These operations are also performed on machines of the same type as those used for the drilling operation.

A number of surface grinding operations are performed on the casings, one of them almost at the beginning of the machining process to obtain accurate locating surfaces for subsequent operations. In Fig. 16 a Thompson surface grinder is shown set up for grinding the two feet on the casings, both on the bottom and on the sides. The work is seen in position for grinding the bottom. It is indexed 90 degrees forward for grinding one side of the feet and 90 degrees backward for finishing the opposite side.

The two sides must be ground true with the center of the breech casing within 0.0005 inch. The tolerance on the dimension to the bottom of the feet is not so close, being 0.002 inch. The small dial indicator attached to the wheel guard



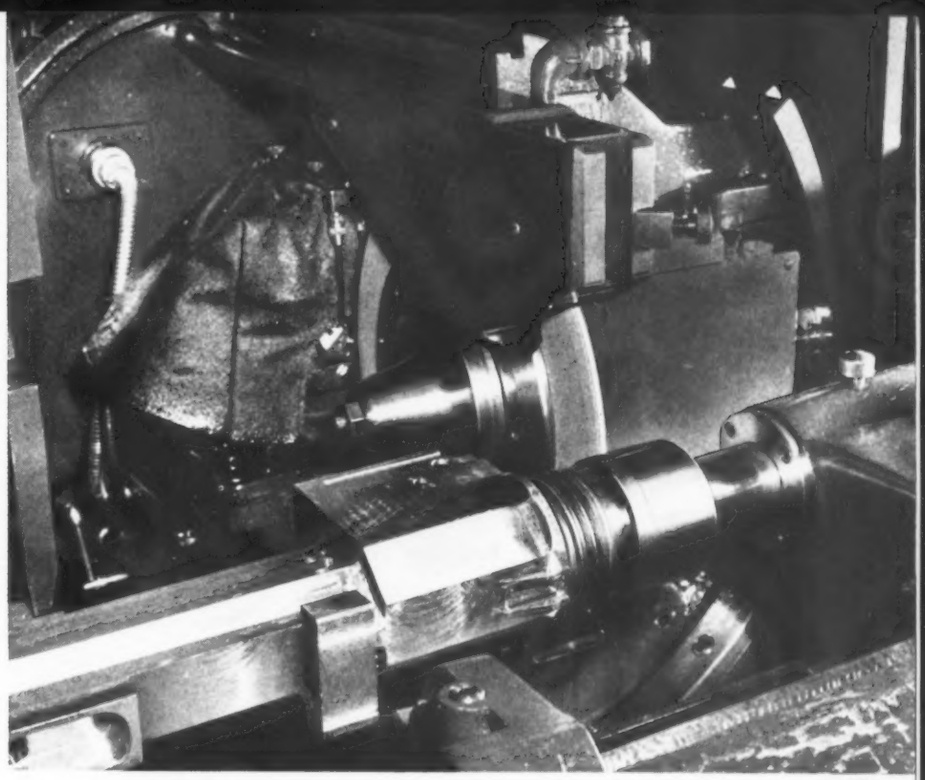


Fig. 19. (Right) Acme Threads are Ground from the Solid on One End of the Breech Casing

Fig. 20. (Below) Another Profile Milling Operation Performed on a Machine in which the Table and Carriage Lead-screws have been Replaced by Hydraulic Cylinders

is used in lining up the feet. Clamps at the front and back are then quickly tightened against the casing by moving handles along bayonet grooves. The finished bores in opposite ends of the casing are seated on plugs of the fixture stocks. Small hardened and ground surface plates attached to the fixture facilitate the use of a second dial indicator for checking the accuracy of the ground surfaces. The top of these small surface plates is in line with the center of the work-piece.

Buffer-spring holes must be drilled in the end of the casing in four groups of three each to a depth of 10 1/2 inches. The arrangement of these holes may be seen in Fig. 17 in the end of a drilled casing that lies on the bed. The drills are 0.457 inch in diameter, and the centers of the holes in any group are only 21 degrees apart, with the result that the wall between two holes is only 1/16 inch thick. These holes are later reamed to 0.473 inch diameter. To prevent the holes from running into each other near their inner ends, a tolerance of only 0.010 inch is specified for straightness throughout the full length of the reamed holes.

The operation is performed on the Natco hydraulically operated step-drilling machine shown. With the work mounted securely in a fixture, four revolving drills are advanced through jig bushings to start the holes. After

Fig. 21. Profile Milling Operation on the Trigger Casings which Involves the Use of a Long Slender Cutter that is Piloted in a Bushing beneath the Work

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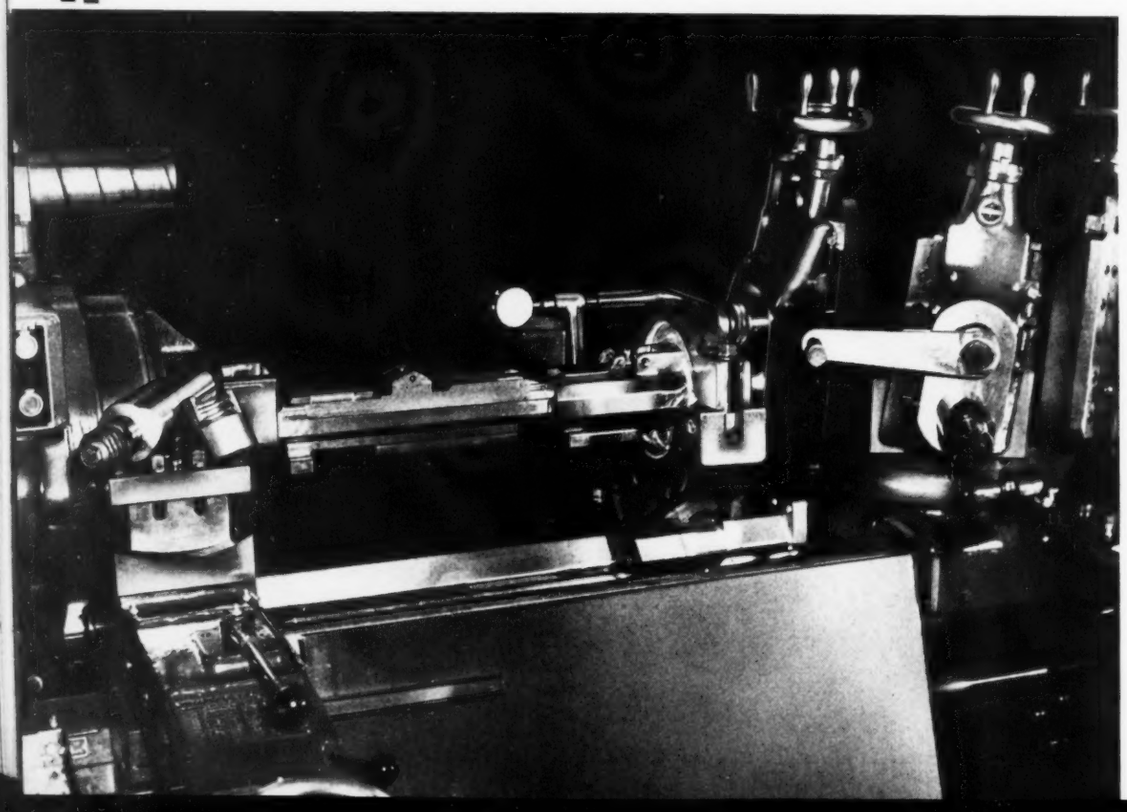
Fig. 22. The Locking Grooves in One End of the Breech Casings are Produced within Limits of 0.0008 Inch in a Turret Lathe Operation, as Here Illustrated

each forward movement of 5/16 inch, the drills recede completely from the holes to permit the chips to be flushed from the holes through oil-gallery holes. On the reamers the oil-gallery holes come out sidewise about 1/2 inch in back of the cutting edges rather than on those edges. This feature eliminates clogging of the oil-holes with chips.

After the drills have progressed sufficiently into the work to be accurately guided by the holes that they have produced, the jig bushing plate is dropped out of position. This facilitates the flushing out of the chips as the drills penetrate to the full depth. When four holes have been drilled, the work fixture is indexed through 21 degrees for drilling the second hole in each group. This step is then repeated for drilling the third hole in each group.

After the drilled end of the casing has been bored out as seen in the part lying on the table of the Milwaukee milling machine in Fig. 12, the walls between the drilled holes must be milled out to a depth of 2 1/2 inches so as to form circular slots. This operation is performed on the machine shown, a milling cutter being used that is only about 1/2 inch in diameter, but that overhangs about 5 inches beyond the machine spindle.

The fixture is of an indexing design, so that the work can be revolved into position for starting each cut. This is done by means of a handwheel at the left-hand end of the fixture. During the cut, the work is revolved through the required arc for cutting the slot after the



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cutter has been fed to depth. This is accomplished by the operator turning the star-wheel at the front of the fixture. Manual power is transmitted through bevel and worm gearing to the work-holding spindle in the right-hand head of the fixture. The length, width, and depth of the slots must be to the specified dimensions within a couple of thousandths inch.

An Acme thread of 0.315 inch pitch and a depth of approximately 0.200 inch is ground from the solid on the breech end of the casing by the Ex-Cell-O thread grinder shown in Fig. 19. The horizontal timing or location of the thread is held within a tolerance of 0.0002 inch and the start within 0.003 inch. To obtain this accuracy, the threads are ground to an indicator. The casing is seated from a ground bore in each end.

Various profile milling operations on the breech casing are performed on standard milling machines provided with duplicating equipment. An operation of this kind is shown in Fig. 18 in progress on a Cincinnati vertical-spindle machine supplied with a Detroit duplicator. Hydraulic equipment controlled from a tracer that moves along a slot in a templet attached to the block mounted on the machine table stops the motor drive to either the table or carriage lead-screw whenever the tracer reaches the end of its movement in either direction. The operator then pushes a button on a control panel to start either the table or carriage feed again. In this way, the work is milled to the templet outline. Some operations per-

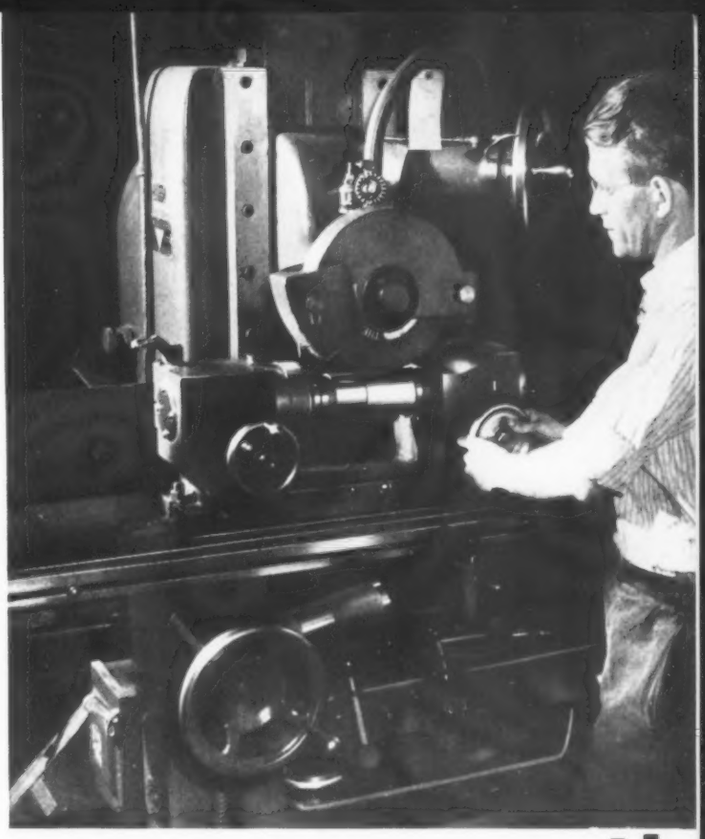

Fig. 23. Relief Grinding Operation on the Trigger Casing in which the Part is Revolved in Small Increments between the Strokes of the Table past the Wheel

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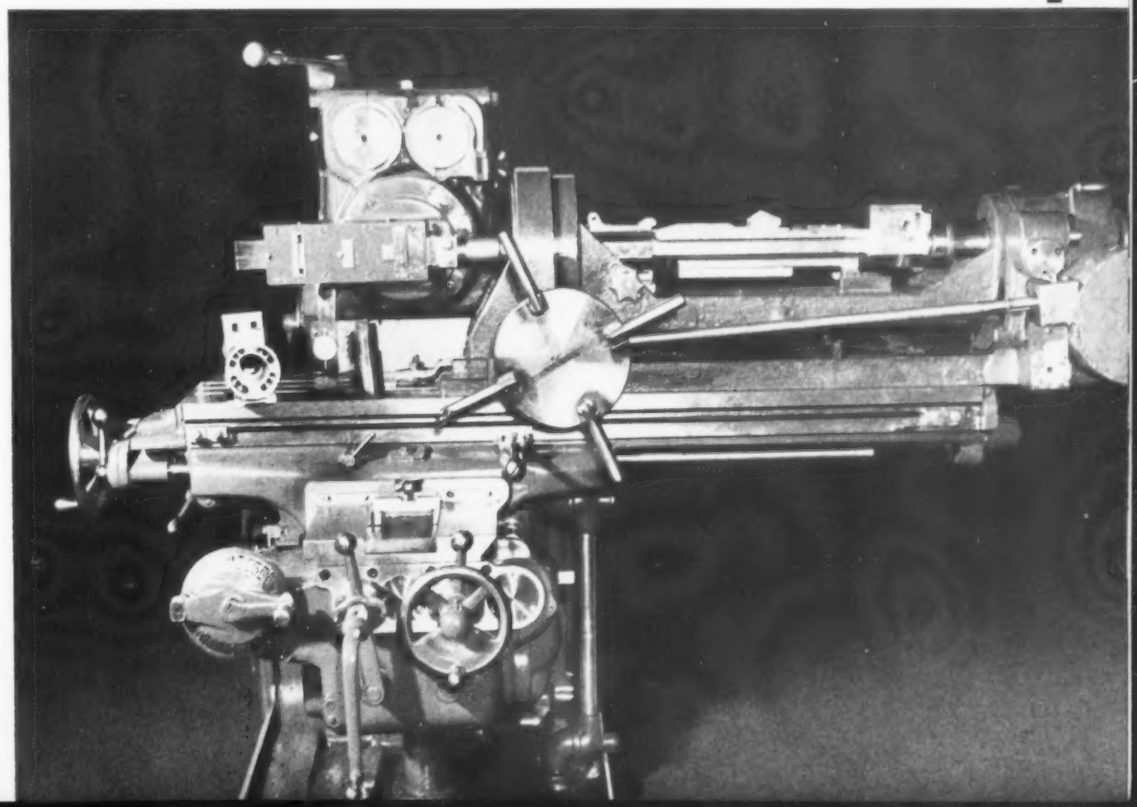
Fig. 24. Interrupting Slots are Cut through the Internal Annular Locking Rings in the Breech Casings by a Slotting Attachment on a Milling Machine



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formed with this duplicator are completely automatic.

In Fig. 20 is shown a Milwaukee vertical-spindle milling machine equipped with a Turchan duplicator which differs essentially from the one just described in that hydraulic cylinders are substituted for the regular table and carriage lead-screws. When the tracer reaches the end of its movement in either direction, the hydraulic feed to the table or carriage is automatically stopped. Then by simply revolving a wheel on one side of the knee, the operator actuates valves to start a work movement in another direction—that is, longitudinally or crosswise with respect to the cutter. In the particular operation shown, a cutter of about 1/2 inch in diameter is fed for a length of 2 inches along the work.

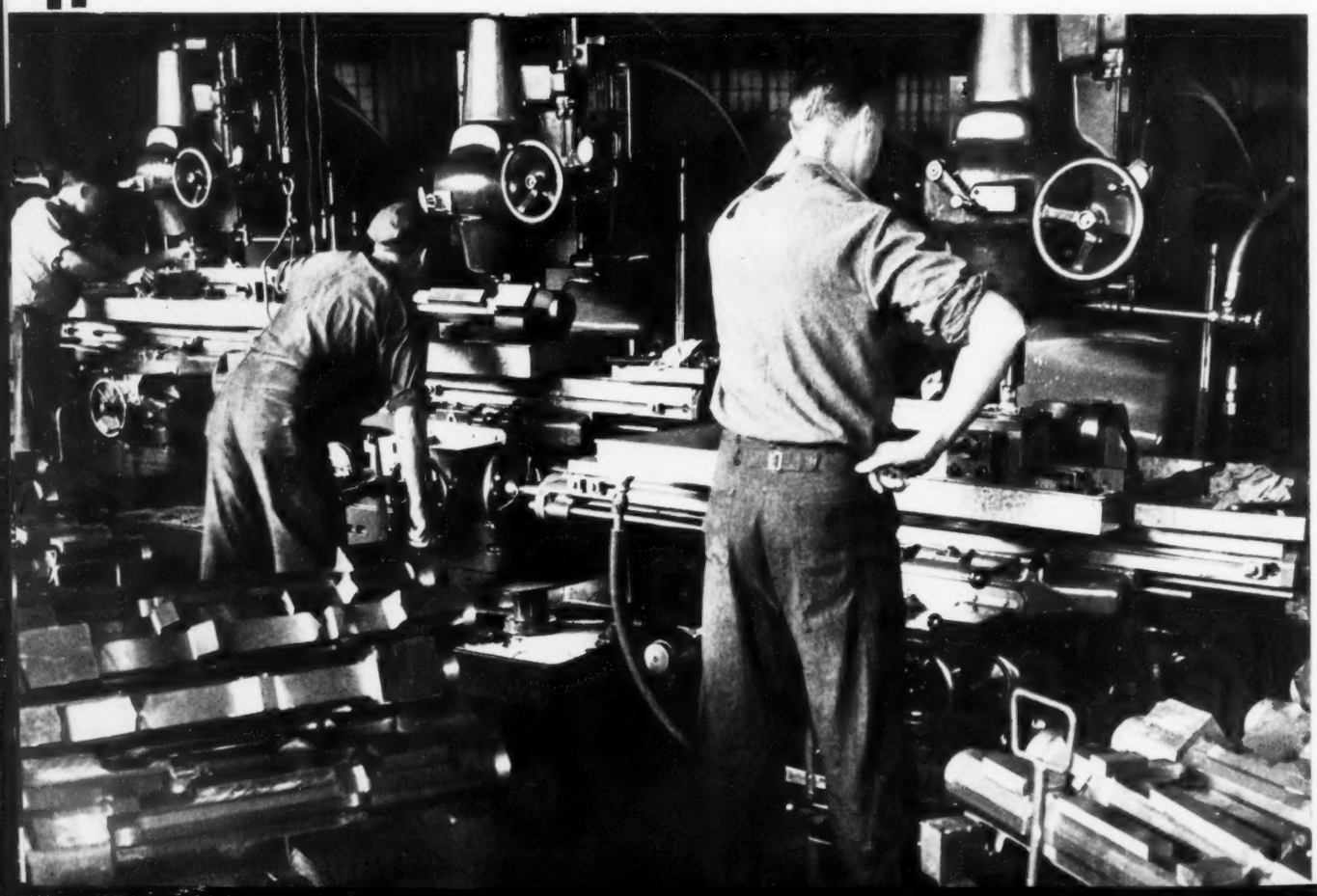
Cutting of annular grooves in the breech casing to mate with the interrupted rings on the barrel is accomplished on a Warner & Swasey turret lathe set up as shown in Fig. 22. The first step of the operation consists of counterboring the barrel end of the casing with a tool on the hexagon turret. This is followed with a finish-boring cut on the same surface and a chamfer. Then a cutter on a slide-head on the third turret station is advanced into the work and fed upward by means of the handwheel on the slide-head to cut a clearance recess at the inner end of the surface to be threaded. Standard turret stops are used to control the forward positions of the tools in these steps of the operation.

A bar equipped with three cutters such as are seen lying on the cross-slide at the left is supplied on a slide-head on the fourth turret face. This tool-bar is fed into the work until a plug mounted on an arm attached to the slide-head comes in contact with the spindle of a dial indicator at the back of the machine and causes the indicator to register zero. The slide is then fed up to cause the three cutters to rough out the annular grooves.

Similar equipment is provided on the fifth turret face to semi-finish the grooves, and on the sixth turret face to finish them. These grooves must be within 0.0008 inch of specified locations when the part leaves the machine, so as to correspond with the rings on the barrel. The end of the casing being grooved is supported by a heavy steadyrest.

The annular rings left after the grooves are cut are partially cut away, to permit quick assembly and disassembly of the gun barrels, by

Fig. 25. General View Showing a Few of the Many Milling Machines Required in the Production of 20-millimeter Anti-aircraft Guns



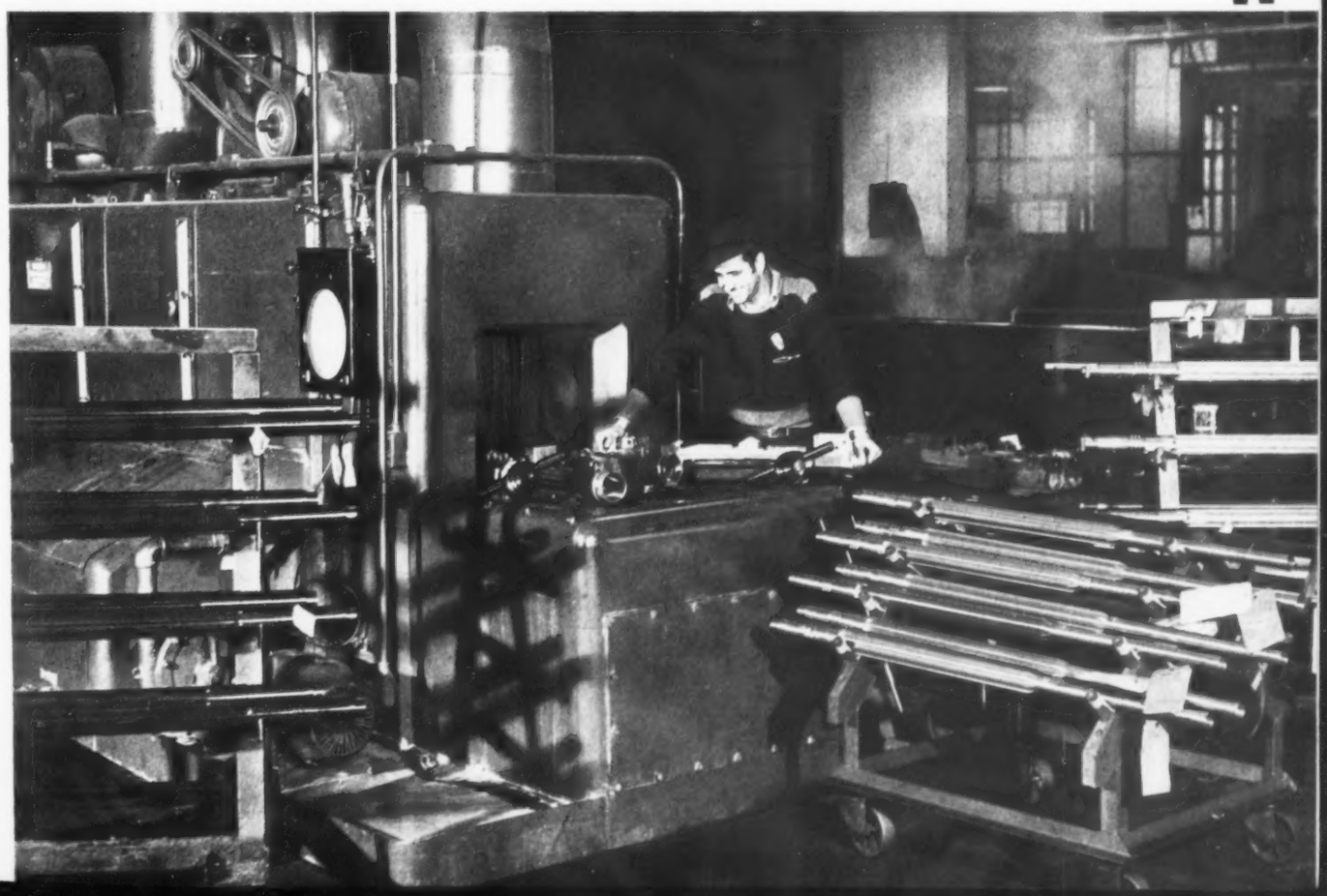
the use of the Milwaukee milling machine shown in Fig. 24, which is equipped with a slotting attachment, actuated by an eccentric on the regular machine spindle. The machine is provided with an indexing and work turning fixture and mechanism similar to that used on the machine shown in Fig. 12. The work must be indexed three times to start cutting as many interrupting slots, and then revolved in small increments between successive strokes of the slotting ram. An extra cutter-bar with its slotting tool is seen at the left-hand end of the table. As in some of the preceding operations, the breech casing is seated on its previously ground feet, as well as being located from the ground bore at one end and a finished external surface at the opposite end.

Many interesting operations are performed on other gun parts in addition to the barrel and breech casing. A typical example is the trigger casing seen in Fig. 21. Here a slot or window of rectangular outline is being profile-milled in the part on a Milwaukee vertical-spindle milling machine. A long slender milling cutter is used which has a pilot on the lower end that is guided in a bushing mounted in an arm that extends forward from the machine column. The cutter pilot is lowered into this bushing after the bushing arm has been fed into the part. Then the work is moved longitudinally and crosswise with respect to the cutter through the operation of a Turchan duplicator similar to the one used on the machine shown in Fig. 20. The templet and tracer which stop the carriage and table movements are seen at the left. This illustration shows a good view of the wheel which is operated to start the hydraulic feeds.

Relief is ground around the trigger casing to a depth of 0.003 inch on the Gallmeyer & Livingston surface grinding machine shown in Fig. 23. An important requirement in this operation is that the lines of demarcation between the relief and the cylindrically ground surfaces must be sharp—that is, without any wave. This requirement can be met only by keeping the machine in constant operation throughout the day. Stock to a depth of 0.022 inch on a side is ground away. The handwheel at the right is used to revolve the work in small increments between successive table strokes. The handwheel at the left is used for clamping the work in the fixture.

All gun parts are thoroughly cleaned in a 20-foot long Howard washing machine, the loading

Fig. 26. Loading End of a Washing, Rinsing, and Drying Machine through which all Gun Parts Pass after being Finish-machined

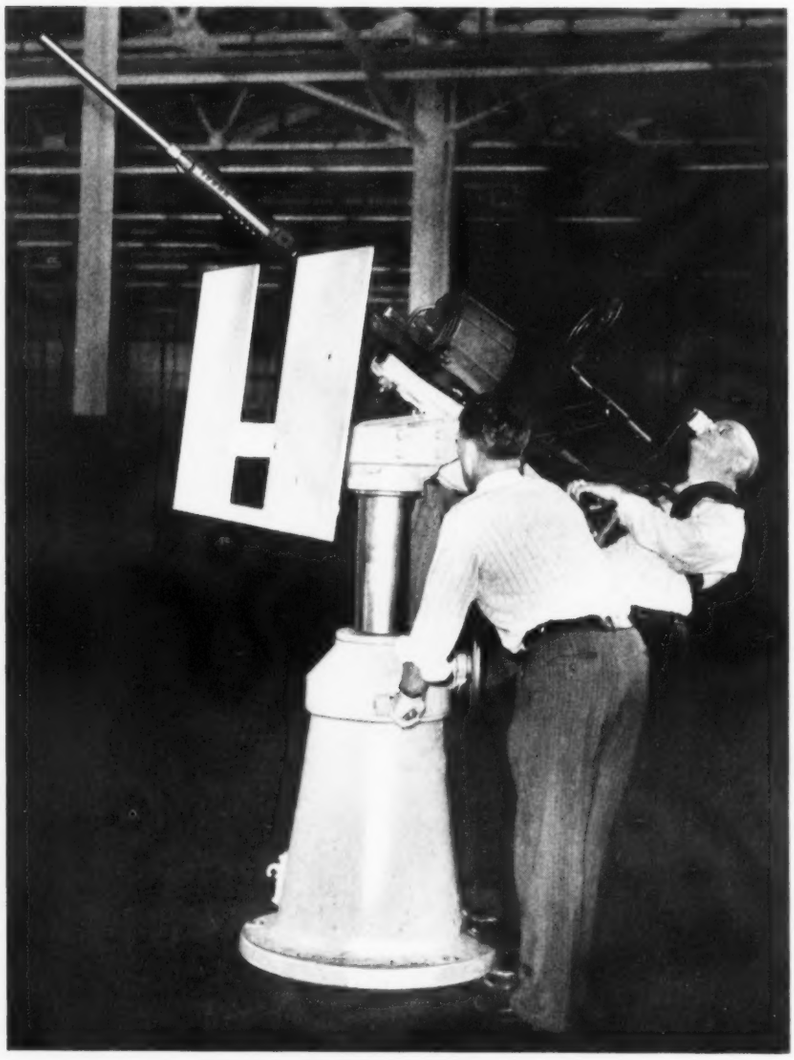


end of which is seen in Fig. 26. As the work is carried through the machine on the steel link conveyor, sprays of water for washing and rinsing are directed on it from all sides. The work-pieces then pass through jets of air, which remove all moisture.

Most of the gun parts are Parkerized after being finish-machined and washed. Parts that go through the Parkerizing process are first sand-blasted in a Pangborn machine.

The guns are completely assembled in this plant and set up on their mounts. All parts are constantly checked for accuracy throughout the manufacturing stages by both company and Navy inspectors. When completely assembled, each gun is checked for firing accuracy in a firing range installed in a long specially built tunnel. The guns are then partially disassembled to enable convenient shipment in wooden crates to Naval establishments.

The 20-millimeter Anti-aircraft Gun, Complete with its Mount



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Engineering News Flashes

The World's Quietest Room

What is said to be the world's quietest room is being constructed in the new Technical Institute Building at Northwestern University. Actually, the construction consists of two rooms, one within the other. The outer room is supported on specially built rubber mountings to absorb any noise-producing shocks. The inner room, as well, is supported on rubber mountings designed by the United States Rubber Co. for the purpose of tuning out vibrations. This inneer room is sound-proof. It measures 14 1/2 by 18 1/2 feet and weighs about 50 tons. It will be used for the purpose of conducting experiments under practically sound-free conditions.

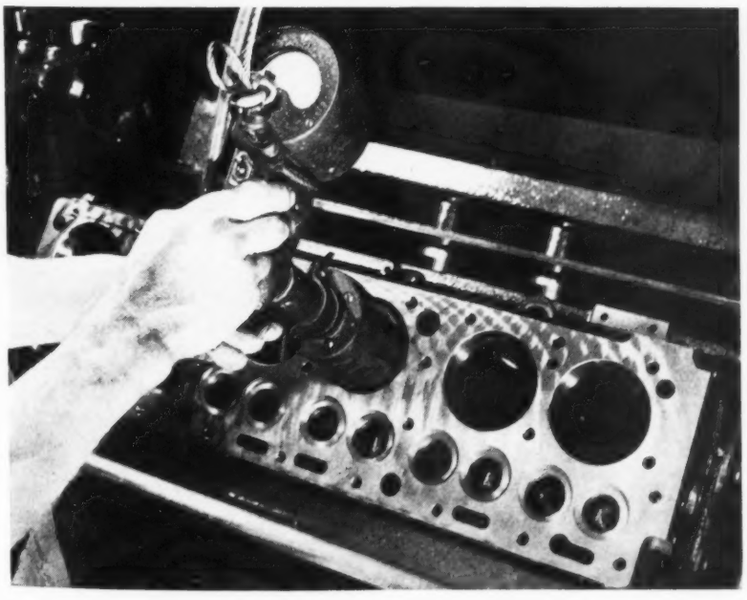
Besides the concrete in the walls, there are eighteen layers of carefully spaced muslin, with other sound-insulating materials lining the walls. The room will make possible extremely accurate tests on musical instruments and vibration in machinery. It will also aid in the solution of theoretical problems in sound absorption.

New Control for Tinning Baths

A new system designed to provide close control and ease of operation in tinning has been developed by the Brown Instrument Co., Philadelphia, Pa. Both the tin bath temperature and the palm oil temperature are controlled by this equipment. The tin bath control consists of a thermo-couple in a seamless-steel protecting tube, which is immersed in the tin bath; a single-record proportioning control potentiometer; a control relay; and a motor and valve. The temperature of the tin bath is measured by the thermo-couple and is recorded by the potentiometer. The proportioning relay and motor serve to accurately control the fuel valve under all conditions of load. The palm-oil bath-control system consists of a sensitive thermo-couple in a stainless-steel protecting tube, which is immersed in the palm oil, and a single-record control potentiometer.

Tanks Made with Cast-Steel Hulls

The first American medium-sized tank with cast-steel hull has just been delivered to the Army Ordnance Department by the American Locomotive Co., Schenectady, N. Y. This tank, known as the M-3A1, will serve as a "pilot" model for other builders, and will eventually supplement the M-3 tank now being built by several industrial concerns. The new tank differs only slightly from the former design, which has a riveted upper and lower hull. The new model has a cast-steel upper hull, the chief advantages of the new design being rounded contours, which deflect shells better than flat surfaces of riveted construction; increased speed of assembly; and less machining.



An Electrical Inspection Gage as Used in the Pontiac Plant, which Measures the Thickness of Cylinder Walls of Automotive Engines by Application on the Inside of the Cylinder Only. The Instrument, Placed by the Inspector in Each Cylinder, Has Coils which Create a Magnetic Field in the Cylinder Walls. The Intensity of the Field Depends upon the Thickness of the Walls. The Gage Has Graduations which Indicate the Thickness in Sixty-fourths of an Inch

EDITORIAL COMMENT

No matter what arguments may be presented by labor union leaders in favor of the "check-off"—the practice by which the employer is required to deduct union dues from the pay check—this practice is wholly unAmerican and contrary to the principles of individual freedom of decision and of action on which this nation was founded.

Furthermore, in legalizing the check-off, the state confers upon union leaders powers over the individual that only the state should have. In principle, the state actually has given to the union the power to levy taxes, because, when enforced payment of membership dues is sanctioned by law, the state has conferred the power of taxation on the organization that collects its dues in that way.

Delegating Power of Taxation to Union Leaders

To the extent that the Wagner Act is responsible for the increasing demand for the check-off, it violates the rights of individual freedom and liberty of action on the part of both employes and employers. We are forced by law into a condition of affairs where neither workers nor those who provide employment are at liberty to use their own judgment in matters concerning their own affairs. When a labor leader can successfully defy the Government of the United States and its President, we are building up a dictatorship that is more harmful to this nation than a political dictatorship would be. What shall we say of a Congress that permits this to happen when we are faced by a serious national emergency? Now that war has actually come, and we must all unite in a supreme effort to save those things for which our country stands, action must be taken if action is needed.

In the last war, the manufacturing industries sometimes found themselves handicapped by the fact that the Government employed inspectors who were not familiar with the product that they were supposed to inspect or with its uses. A letter that we recently received suggests that possibly there is a tendency to repeat the practice of appointing inspectors with inadequate experience.

A correspondent writes us for information that would be of value to him in the inspection of die-castings; iron and bronze sand-castings; steel, brass, and bronze sheets and bars; punch press products; forgings; hobs; "mills"; drill presses; boring machines; parts machined on lathes; girders; steel parts that have been cyanided, carburized, nitrided, or hardened; tool steel; oil-hardening drill rod; various finishes, such as cadmium, copper, nickel, tin, and chromium plating; baked black rubber enamel and other baked enamels; synthetic plastics, as, for example, Neoprene and Lucite; and welded, riveted, die-staked and hand-assembled sub-assemblies.

A Good Inspector Cannot be a Jack-of-all-Trades

"I wish," he writes, "to gain a general background of knowledge concerning all the varied processes indicated above as a basis for specific knowledge of the inspection methods for each class of product. I would not expect to find all this in one or even a few books, but would rather expect to find the information in monographs on the various subjects. The books selected will be more valuable to me if they contain some information—a chapter at least—on the inspection of the particular product discussed."

It seems doubtful if any man starting from scratch, or anywhere near it, could acquire the necessary knowledge for properly inspecting such a varied line of products even with a truckload of books as a background for practical experience. Since modern manufacturing is based largely on specialization, and since inspection is a final and vital link in the manufacturing chain, specialization in inspection also appears to be essential. When the inspector is a Jack-of-all-trades, he, himself, doubtless needs more inspection and supervision than the manufactured product. In this time of stress, adequate and conscientious inspection must be carried out by men having practical specialized experience of a high order.

Practical Experience Essential to Proper Inspection

Ingenious Mechanical Movements

Mechanisms Selected by Experienced Machine Designers as Typical Examples Applicable in the Construction of Automatic Machines and Other Devices

Mechanism for Producing Variable Reciprocating Movement

By L. KASPER

A mechanism designed to produce a reciprocating movement of constantly varying length of stroke, constructed for use on a wire weaving machine, is shown in the accompanying illustrations. It was desired to produce an irregular pattern of no definite accuracy in the woven wire product, the main requirement being that the "repeat" patterns be identical. To produce the desired pattern, it was necessary that the length of travel of the reciprocating work-head vary throughout the repeat movement. By means of the mechanism illustrated, the work-head is given a gradual, but not uniform, increase and decrease in the length of stroke.

Referring to Fig. 1, the drive-shaft *A* is carried in bearing *I*, attached to a stationary part *H* of the machine. Gear *B* is keyed to shaft *A*, and rotates in the direction indicated by the arrow. The hub on one side of bearing *I* is machined to support the lever *J*, which is free to oscillate on the hub. Lever *J* carries the gear *C*, which is free on its stud and meshes with gear *B*. Gear *D* rotates freely on the stud at the end of lever *J*, and meshes with gear *C*.

The connecting-rod *F* is attached to gear *D* by the stud *L*, and to the work-head *G* at the opposite end. The connecting-rod *E* is attached to gear *C* by stud *K* at one end, and to the stationary part *H* at the other end. Gears *B* and *C* have the same number of teeth, while gear *D* has one more tooth. On the machine as constructed, gears *B* and *C* each have thirty-six teeth, while gear *D* has thirty-seven teeth, the effect being to maintain a constant definite relationship between gears *B* and *C*, and a constantly varying relationship between *C* and *D* throughout the cycle.

In Fig. 1, the work-head *G* is shown at its extreme left-hand position. Gear *B*, rotating in the direction indicated by the arrow, causes gear *C* to rotate in the opposite direction. The rotation of gear *C* causes stud *K* to change its position relative to the stud carrying gear *C*, so that lever *J* is moved or pivoted to the right, the extent of the oscillation being determined by the diameter of the circular path of stud *K*, as measured horizontally on the line of travel of the stud carrying gear *C*.

The rotation of gear *C* causes gear *D* to ro-

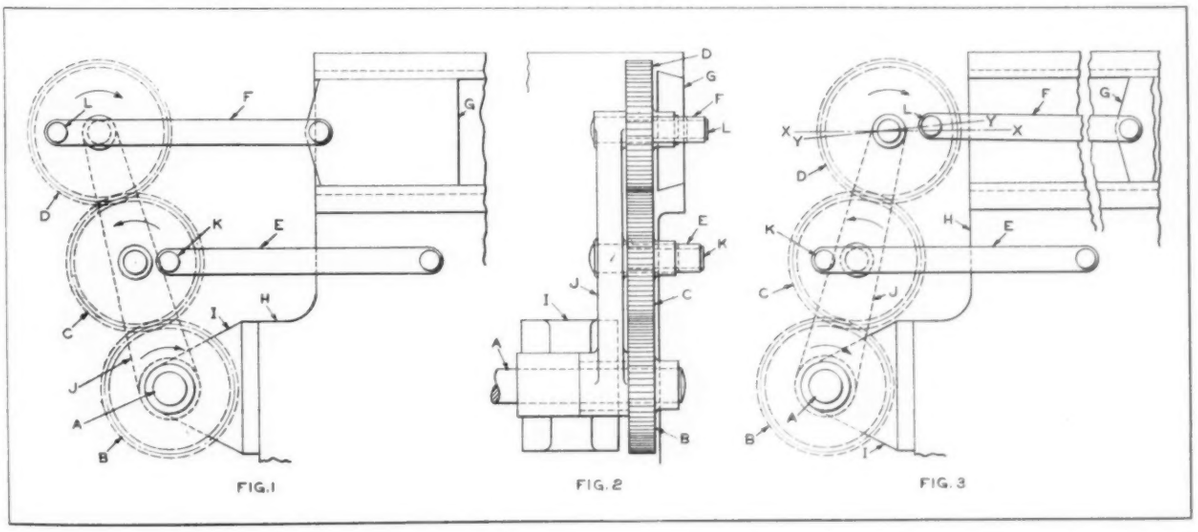


Fig. 1. Diagrammatic View of Mechanism for Producing Variable Reciprocating Movement of Slide G
Fig. 2. End View of Mechanism Shown in Fig. 1. Fig. 3. View Showing Relative Positions of Gears and Slide G after One-half Revolution of Driving Gear B

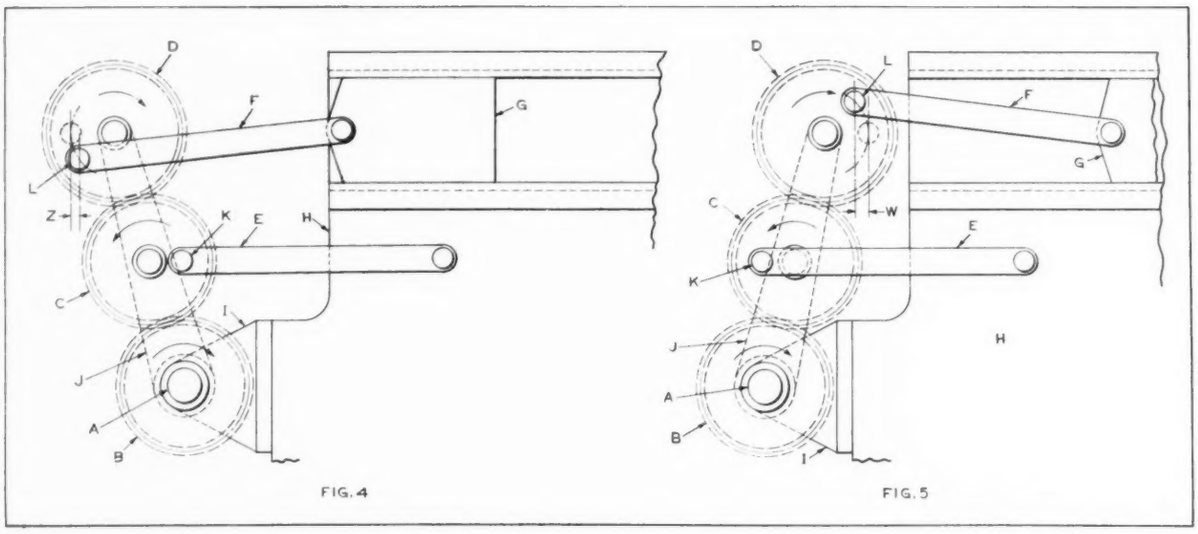


Fig. 4. Diagram Showing Relative Positions of Parts of Mechanism Shown in Fig. 1 after Gear B has Made Four Complete Revolutions. Fig. 5. Mechanism with Lever J in the Same Position as in Fig. 3, but with Stroke of Slide G Shortened by Distance W

tate on its stud in the direction indicated by the arrow, and as stud *L* rotates around the center of gear *D*, the radius of rotation is added to the horizontal movement of the upper end of lever *J*. As gears *B* and *C* have the same number of teeth, lever *J* passes through one cycle of oscillation to each revolution of gear *B*, but as gear *D* has one tooth more than gear *C*, it does not complete a full revolution to each revolution of gear *B*, and stud *L*, therefore, has not quite reached its extreme right-hand position, as is shown in Fig. 3.

Fig. 3 shows gears *B* and *C* revolved one-half turn from the positions shown in Fig. 1, but gear *D* is one-half tooth short of having completed a half turn. The line *X–X*, drawn radially through the centers of gear *D* and stud *L* indicates the position which gear *D* occupied in Fig. 1. The line *Y–Y*, similarly drawn, indicates the present position after the half-turn of gear *B*. Although the movement of stud *L* has been added to the movement of the upper end of lever *J*, the movement is slightly, though negligibly, less than would be the case if gear *D* had completed a half-turn. Thus, with each rotation of gear *B*, there is one tooth space difference in the relative position of gear *D*, and a corresponding difference in the position of the work-head *G* at the ends of its stroke.

Fig. 4 shows gear *B* after having completed four revolutions. Gear *C* likewise has completed four revolutions, lever *J* and rod *E* occupying the same positions as in Fig. 1. Gear *D*, however, is the equivalent of four tooth spaces short of having completed four revolutions, and the stud *L* has not reached its extreme left-hand position. The travel of the work-head *G* to the left, therefore, has been decreased at this point to a distance equal to the horizontal distance between the original and the present position of the stud *L*, represented by the dimension *Z*.

In Fig. 5, lever *J* occupies the same position as in Fig. 3, and the stroke of the slide or work-head *G* to the right has been shortened by the distance *W*. Thus, with each revolution of gear *B*, there is a decrease in the stroke of work-head *G*, until gear *D* has completed a half revolution on its stud, when the conditions are reversed and there is a gradual increase in stroke length until gear *D* has made a full revolution, which completes a cycle or "repeat" movement.

* * *

Compulsory Working of Patents

A comprehensive review of the proposed changes in the patent laws relating to the compulsory granting of licenses on any patent to anyone willing to pay a fair compensation to the patent owner has been prepared by A. Luzzatto, associate of Edgar Luzzatto & Co., 570 Seventh Ave., New York City. Copies of this review can be obtained by applying to the author at the address given.

In his review of the proposed patent legislation, Mr. Luzzatto points out the objections to the proposed changes. He emphasizes that the changes that are supposed to benefit small manufacturers, as compared with concerns of greater resources, may actually have the contrary effect. He then suggests a system of licensing that would be free from the objections raised to the compulsory licensing that would be authorized if the proposed changes in the patent laws were enacted into law.

Heat-Treatment of Molybdenum High-Speed Steels

Controlled-Atmosphere Furnace and Salt Bath Methods of Hardening—Second of Two Articles Covering Recommendations of a Special Committee of the United States Office of Production Management

MOLYBDENUM high-speed steels have a tendency to develop a soft surface when heated to the hardening temperatures. Because of this, it is important to exercise certain well established precautions to protect the surface of these steels. This can be accomplished by the application of protective coatings when conventional type furnaces are employed, or by the use of high-temperature salt baths.

Atmosphere-controlled furnaces also satisfy this requirement for surface protection against attack, and these furnaces are now available in both electric and fuel-fired types where the atmosphere is independent of the source of heat. This permits control of the atmosphere in contact with the work to be treated, so that small and delicate pieces can be given the heat-treatment that will develop the good properties of the steel without injuring the surface or overheating thin projections.

Controlled-Atmosphere Methods

The ideal atmosphere is, of course, one that is not harmful to the steel, and the atmospheres commonly used are products of combustion and inert gases, both of which have been cleaned of undesirable constituents and closely regulated as to composition. Thus, an atmosphere for the successful heat-treatment of molybdenum high-speed steels must be capable of (1) preventing decarburization; (2) preventing excessive carburization which will cause wrinkling of the surface, melting of the edges, pitting, and embrittlement of the cutting edge; and (3) preventing harmful scale or oxidation.

Preheat Temperatures—To prevent the changes mentioned from taking place, the atmosphere for the preheat temperature is just as important as the atmosphere for the high-heat temperature, and should have the same characteristics. A high-heat furnace with a satisfactory atmosphere will be of no value if the proper atmosphere is not used in the preheat furnace.

High-Heat Temperatures—As any one of several atmosphere-control methods may be used, no general recommendations can be made regarding settings and methods of operation, but competent engineering service should be supplied by the furnace manufacturers. Complete operating information should always be given by the service engineers after the furnaces are installed.

In the selection of atmosphere-controlled furnaces, the purchaser should secure a guarantee that the furnace selected will satisfactorily harden molybdenum high-speed steels for his particular needs without the use of surface-coating materials. Manufacturers of controlled-atmosphere furnaces will, upon request, supply bulletins and complete descriptions of their equipment. These firms also extend engineering and metallurgical assistance to furnace users, and heat-treat samples, or permit those interested to heat-treat their own samples, in the equipment under consideration.

Salt-Bath Furnaces

One of the factors that has made possible the adoption of molybdenum high-speed steels as a substitute for the 18-4-1 type of steels has been the electric salt-bath method of hardening. Because molybdenum high-speed steels decarburize when heated, the conventional type furnaces are not satisfactory for hardening them. The electric salt-bath method, when properly controlled, eliminates this decarburization, and is satisfactory for all types of molybdenum high-speed steels.

In general, immersed-electrode furnaces are being used when there is sufficient production to keep the furnaces operating at a reasonable capacity. There are on the market several types of immersed-electrode salt-bath furnaces and several types of salt baths. As a guide to those who are considering the purchase or installation of equipment of this type, it is suggested that the selection of such equipment be based on the following recommendations, modified, of course, by the specific production requirements of the case in hand:

For heavy production and constant use, a three-pot unit consisting of (a) immersed-electrode salt-bath preheat furnace; (b) immersed-electrode salt-bath high-heat furnace; (c) immersed-electrode salt-bath quench furnace. For extremely heavy production or large or intricate sections, two preheats are advantageous; the first preheat should be operated at 1100 to 1300 degrees F., and the second one at 1500 to 1600 degrees F.

For medium or light production, but used intermittently, a three-pot unit consisting of (a) gas- or oil-heated salt-bath preheat furnace; (b) immersed-electrode salt-bath high-heat furnace; (c) gas- or oil-heated salt-bath quench furnace.

The immersed electrodes generate heat directly in the molten salt bath by the electrical resistance of the bath material, and produce a positive circulation of the bath, due to the internal stirring action caused by the electrical flow between the electrodes. This stirring action increases the speed of heating and eliminates local overheating, thus aiding close temperature control, which is always advantageous. A properly selected and maintained salt bath prevents scaling or oxidation of the work, as well as surface decarburization.

Decarburization or pitting in the high-heat salt bath is usually caused by the presence of oxides. However, the manufacturers of salt baths supply a neutral bath containing a suitable deoxidizer or rectifier, which is sufficient to keep the bath free from oxides under normal operating conditions. Under abnormal operating conditions, where a sufficient amount of new salt has not been added, it becomes necessary to make supplementary additions of the rectifier material. The manufacturers will supply information as to procedures for simple chemical control to maintain the salt bath in a suitable condition. When a refractory or brick-lined pot is used, there is less tendency for oxides to form in the bath.

Procedure for Salt-Bath Hardening

Briefly, the procedure for salt-bath hardening is as follows:

1. Clean work to free it from scale, rust, oil, grease, and moisture. Use either a solvent degreaser or a suitable alkaline cleaner, followed by a clean hot water rinse, and thorough drying. Every precaution must be taken to prevent moisture on tools that are going into the salt bath, as wet tools may cause a steam explosion and burn the operator.

2. Immerse in preheat salt bath having a temperature of 1500 to 1550 degrees F. Allow sufficient time for the work to reach the temperature of the bath.

3. Transfer to high-heat salt bath having a temperature of 2150 to 2250 degrees F. Allow sufficient time for work to reach temperature of bath plus proper soaking time at temperature. (See the heat-treating practice outlined in the previous article, published in the December number of MACHINERY, page 152.

4. Transfer to quench bath having a temperature of 1100 to 1200 degrees F. Allow sufficient time to cool to bath temperature. Two to five minutes will suffice, depending upon size. Remove from salt bath and cool in air or oil. Quenching in oil is not recommended for work of intricate design or for work where distortion is likely to occur.

5. After the work has cooled to room temperature, wash off all salts in a hot alkaline cleaner. In cases where a furnace (air atmosphere) is to be used for tempering, the work should be shot- or sand-blasted, or cleaned by other methods, to insure the removal of all salts. If this is not done, the salt will attack the work during the tempering. Where a salt bath is to be used for tempering, the work need only be cleaned in a hot alkaline solution or hot water.

6. For tempering, see the practice outlined in the previous article.

Effect of Salt-Bath Hardening

A. Molybdenum high-speed steels, when hardened in salt baths, are entirely surrounded by neutral molten salt. A salt film is retained on the tool throughout the hardening procedure, thus preventing decarburization or scaling.

B. The salt-bath hardening method provides uniform heating, and this generally results in less distortion. All sections of intricately shaped tools are uniformly heated by this method. The salt bath permits selective hardening.

C. When a salt bath is properly selected and maintained, there is no chemical attack on the molybdenum high-speed steels. The original surface of the steel is retained.

Molybdenum high-speed steels will take all the special surface treatments, including nitriding when immersed in molten cyanide, that are applied to tungsten high-speed steels for certain applications.

* * *

It has been estimated that the production of machine tools in the United States in 1940 and 1941 amounted to approximately 300,000 new machines. This is about one-third of the total number of machine tools in American plants at the beginning of 1940. Furthermore, the productive capacity of these new machines is far greater than that of corresponding machines built years ago.

Resharpening Broaches to Obtain Longer Life

By HARRY GOTBERG, Chief Engineer
Colonial Broach Co., Detroit, Mich.

OBTAINING longer life from broaches involves two factors—correct sharpening, and proper storage and handling. Sharpening, or rather resharpening, should be undertaken with the object of restoring the cutting edges of the broach to their original condition. Broaches should always be handled and stored just as carefully by the user as they are by the manufacturer before shipment to the customer.

Since broaches are generally made from hardened high-speed steel and may be equipped with sections of tungsten carbide, the cutting edges of the teeth are easily chipped or nicked by dropping the broach on a hardened surface or by other careless handling. Individual storage pockets or bins should always be provided to prevent the cutting edges of the teeth of several broaches from striking against one another. The compartments of the bin should either be of a material that will protect the teeth from damage or else be lined with such a material.

Resharpening a broach to restore its original cutting quality implies the necessity for using special equipment developed for the purpose. Makeshift or improvised equipment cannot be expected to produce the accuracy and finish obtained with the special broach-sharpening machines now available. The sharpening equipment should be kept in first-class condition, and should be operated by men familiar with the essential requirements of the broach-sharpening operation. Satisfactory broach performance and length of life can be obtained only if the cutting edges are maintained as originally designed. Any marked departure from the original size and form of the teeth will result in incorrect cutting action and possibly irreparable damage.

Fig. 1 illustrates the proper method of sharpening broach teeth. It should be carefully noted that the correct form and contour of the teeth are accurately maintained. The original tooth form permits the chip to curl and clear itself from the edge of the tooth that is in the cutting position. The illustration also indicates the effect of successive sharpenings, as well as the proper chip form. If there is any doubt as to the correct tooth form, a blueprint of the broach tooth as originally ground should be used as a guide.

Fig. 2 shows an incorrect method of sharpening. The original tooth contour in this case has not been maintained. The edge of the cutting wheel has produced a groove below the proper curvature of the tooth form, thus creating a pocket which will prevent the chip from clearing the point of the tooth. Chips will "load up" in the pocket, decreasing the distance normally available for chip clearance. Depriving the teeth of their full chip clearance may result in a broken broach. This is most likely to happen in broaching steel parts where a continuous chip is produced.

A smooth finish on the broach teeth is essential to the production of a smooth surface on the broached part. It permits the chip to move freely along the surface of the entire tooth form

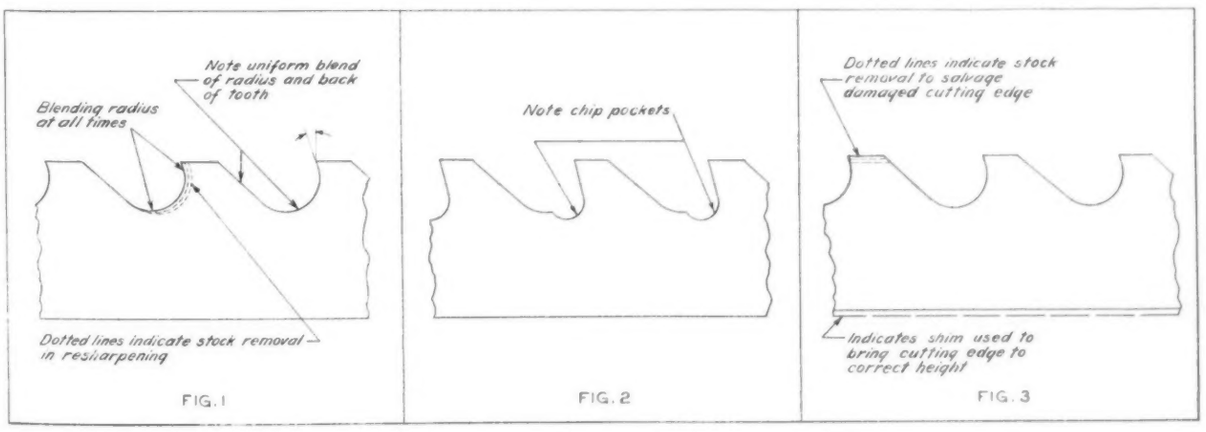

Note uniform blend of radius and back of tooth
Blending radius at all times
Dotted lines indicate stock removal in resharpening
FIG. 1
Note chip pockets
FIG. 2
Dotted lines indicate stock removal to salvage damaged cutting edge
Indicates shim used to bring cutting edge to correct height
FIG. 3

Fig. 1. Diagram Showing Form of Correctly Sharpened Broach Tooth

Fig. 2. Diagram Showing Form of Incorrectly Sharpened Broach Tooth

Fig. 3. Method Used to Salvage Broach with Damaged Cutting Edge

and will create a natural rounded chip, allowing maximum chip space between the teeth. A smooth finish on the broach teeth will also help to produce a greater number of parts between sharpenings, since there is less tendency for the cutting edges of the teeth to break down than when the edges are rough.

In the case of surface broaches designed for use in a broach-holder, or where adjustment or "shimming" to increase the broach height is allowed, the teeth can be reconditioned by re-stepping and rebacking off the top of the tooth form, as shown in Fig. 3. This operation requires extreme care, since the proper stepping, backing off, and tooth depth must be maintained. In most cases, the broach should be sent to the maker for this work, since the machines originally employed for producing the broach can then be utilized to restore the broach to its initial condition at nominal expense.

Fig. 4 shows a type of hook and radius gage that is suitable for checking or determining if the radius at the bottom of the tooth form and the hook angle are correct. Gages of this kind are practically indispensable in machining broaches and in keeping broaches at peak efficiency, and they are of material aid in preventing damage from incorrect sharpening.

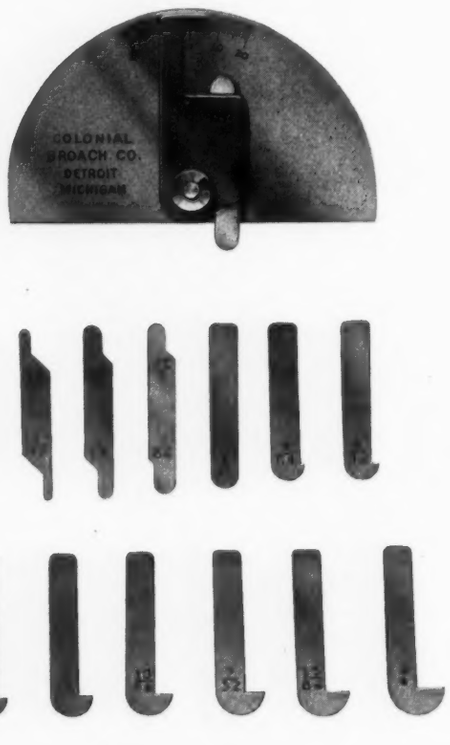


Fig. 4. Gages for Checking Hook and Radius of Broach Tooth to Insure Accurate Resharpening

A Convenient Holder for Carbide Tools

Holder and Carrier for Carbide Tools

A carbide-tool carrier design which has proved practical and useful is shown in the accompanying illustration. According to the Carboloy Company, Inc., Detroit, Mich., this carrier has been found especially useful in job shops, where the diversity of work requires the use of a fairly wide range of tools, which must be readily available to the operator. The carrier allows for segregating the tools according to grade, style, and type of work on which they are used. It also facilitates tool handling, as the carrier can be kept intact in the tool-crib and issued as a unit to the machine operator.

* * *

Westinghouse Saves Sixty Tons of Aluminum from Scrap Every Month

Enough aluminum to build ten army bombers is reclaimed every month from machine shop scrap at the Westinghouse plants. Of the 500 tons of non-ferrous metals reclaimed in one month from scrap in these shops, aluminum accounted for 60 tons. Besides aluminum, the reclaimed metals include copper, aluminum alloys, and copper alloys.

The procedure is briefly as follows: First, pure aluminum and copper are removed from the metal chips, and the remainder is divided into a large number of alloy groups. The chips of each group are placed in a revolving bucket and thoroughly mixed together. A test is then made to determine exactly what metals it contains and how much of each is present. To get the right percentage of the metals to form a specific alloy, certain amounts of pure metals are added.

The metals are then melted in huge gas furnaces, which handle up to 20,000 pounds at one time. The molten metal is poured into molds to form 100-pound ingots. These ingots are again tested for chemical analysis, and then assigned identification numbers. These metals are then used for making various types of castings.

MACHINERY'S DATA SHEETS 457 and 458

TYPICAL APPLICATIONS OF SAE STEELS—7

This listing, based on the 1941 SAE classification of steels, is not intended to be complete, but rather to indicate by typical examples what steels are suitable for various types of applications.

Frogs

See Agricultural Machinery Parts.

Gears

Medium-carbon steel No. 1045 is used for starter ring gears.

Nickel steel No. 2315 is used for gears of high strength and accuracy.

Nickel steel No. 2345 has been used successfully for gears.

5 per cent nickel steel No. 2515 is one of the most dependable of the structural steels, but will not give the surface hardness of some of the other steels, due to retained austenite often present in the hardened case.

Nickel-chromium steels Nos. 3115 and 3120 are intended primarily for carburized parts, and are used for ring gears and pinions, as well as for transmission gearing.

Nickel-chromium steels Nos. 3145 and 3150 are used primarily for gears of the oil-hardened type.

Nickel-chromium steels Nos. 3245 and 3250 are intended for oil-hardened parts, machined or forged, requiring high physical properties. They are used for heavy-duty gears.

Nickel-chromium steel No. 3312, intended for carburized parts when a core having high strength and toughness is desired, is used for rear-axle gears and transmission gears on heavy-duty trucks and buses.

Nickel-chromium steel No. 3415 has similar applications to those of steel No. 3312.

Molybdenum steel No. 4320 is used for gears of high strength, such as rear-axle gears, and also for pinions.

Chromium-nickel-molybdenum steel No. X4340 is suitable for oil-hardening gears.

Molybdenum steels Nos. 4615 and 4620 are suitable for carburized gears where high fatigue resistance and tensile strength are needed. Steel No. 4620 is used for heavier sections.

Molybdenum steel No. 4640 is used extensively for gears where high fatigue resistance and physical properties are required. The fine-grained types are excellent steels where minimum distortion is a prerequisite.

Molybdenum steels Nos. 4815 and 4820 are used interchangeably with 5 per cent nickel steels for gears. Steel No. 4820 is used for the larger sizes of gears. An outstanding advantage of steel No. 4815 is the high core strength that can be developed with a single quench. Recommended for heavy duty.

Chromium alloy steel No. 5120 is the deep-hardening type which hardens satisfactorily in oil. It has properties equal to those of steels Nos. 2315 and 3120, except that it does not have a tough fibrous core.

Chromium alloy steel No. 5140 is used extensively for gears that are hardened by direct cyaniding.

Chromium alloy steel No. 5150 is an oil-hardening type for deep-hardening gears.

Chromium-vanadium steel No. 6150 is suitable for heat-treated gears subject to severe conditions, in cases where high strength and anti-fatigue properties are essential.

MACHINERY'S Data Sheet No. 457, January, 1942

TYPICAL APPLICATIONS OF SAE STEELS—8

This listing, based on the 1941 SAE classification of steels, is not intended to be complete, but rather to indicate by typical examples what steels are suitable for various types of applications.

Harrow Disks

See Agricultural Machinery Parts.

Hay-Rake Teeth

See Agricultural Machinery Parts.

Keys

Low-carbon steel No. 1030, which machines satisfactorily, either without annealing or after a simple normalizing, is used for key stock.

High-carbon steel No. 1090.

High-carbon steel No. 1095.

Nickel steel No. 2330 is used where considerable strength and toughness are sought.

Nickel-chromium steel No. 3130 is used for water-quenched parts where greater strength and toughness are required than are possible with plain carbon steels.

Knotter Disks

See Agricultural Machinery Parts.

Knuckles, Steering

Nickel-chromium steel No. X3140 is used. This steel has improved hardening characteristics compared with steel No. 3140.

Lamps, Automobile

Low-carbon steels Nos. 1010 and 1015, which have good deep-drawing characteristics and provide excellent surface finish, are used.

Levers

Low-carbon steel No. 1030 for shift and brake levers.

Medium-carbon steel No. 1040, suitable for small and medium-sized plain carbon-steel forgings, is used for brake levers.

Nickel steel No. 2330 is used for levers where considerable strength and toughness are required.

Links for Drive Chains

Nickel-chromium steels Nos. 3135 and 3140 are used for a great many heat-treated parts where good physical properties are required.

Molds, Agricultural

See Agricultural Machinery Parts.

Mower Knives

See Agricultural Machinery Parts.

Mower Sections

See Agricultural Machinery Parts.

Music Wire

High-carbon steel No. 1085.

Nuts for Heavy Duty

Nickel steel No. 2330 is used where considerable strength and toughness are required.

Nickel-chromium steel No. 3130 is used for water-quenched parts where greater strength and toughness are required than can be obtained with plain carbon steels.

Oil-Pans

Low-carbon steels Nos. 1010 and 1015 are available in deep-drawing strip.

MACHINERY'S Data Sheet No. 458, January, 1942

Historical Notes on the Tap and Die Industry

By JOHN E. WINTER, President
Winter Brothers Co., Wrentham, Mass.

THE chief use for metal in the early days was in weapons and armor, and it is in armor that we find the first samples of pieces threaded to hold them together. Most of the metal pieces of the armor were fastened to leather or to one another by rivets; but to complete the assembly in some instances after the armor was put on, external and internal threaded pieces were sometimes used, at least as far back as the thirteenth century.

The production of these threaded parts must have been a slow and expensive hand operation. There is no definite record of any mechanical equipment for cutting threads until 1564, when a historical note indicates that some kind of screw-cutting lathe was in use. Of course, it was entirely hand-operated. Not until 1740 do we hear of a geared screw-cutting lathe, and the slide-rest did not come into use until about 1800. It is practically certain that before 1800 most of the taps and dies used were made entirely without the aid of machinery.

Earliest Taps and Dies Still Preserved

In the Museum of Peaceful Arts in New York City, there is a set of taps and a "jamb plate" that were made in Wrentham, Mass., during revolutionary days. The taps were forged to size with the part to be threaded tapered its entire length. The threading was obviously laboriously done with a file, and the narrow flutes were also filed. The jamb plate for forming external threads was, of necessity, threaded by the same tap as was used for threading the nut, as this was the only possible way to match the thread form and lead of the threaded parts.

Tools of this style and of gradually improving workmanship continued to be the principal threading tools for many years. The tapering threads were quite convenient when there were no standard sizes, as parts could be assembled until there was an apparent fit. The fact that the mating parts usually fitted on one thread only seemed to cause no worry. It is easy to understand how we got the terms "jamb plates" and "blacksmith's taper taps." The latter type of tap has not yet entirely disappeared, and is still listed by some tap manufacturers.

Although there must have been a good many taps in use before 1800, it is in that year that we find the first record of taps manufactured for the market by Henry Maudsley in England. Maudsley, as is well known, was one of the most distinguished mechanics of his time. He was the inventor of the slide-rest, which greatly increased the efficiency of the crude lathes of that day.

Before the use of a lathe with a lead-screw, but after the development of foot-power operated lathes, most thread cutting was done with chasers usually called "comb chasers" in England. Considerable skill was required to obtain good results with them, as it was necessary for the operator to slide the chaser along so that it advanced one thread for each revolution of the work—no mean job when starting to cut a thread on work rotated by foot power. The operators became so skillful in the use of chasers that this means of threading has been in use on some classes of work until recent years, and these chasers are still listed in some catalogues. They are now used chiefly, however, to clean out threads already cut.

Early Screw Thread Systems

The earliest attempt to establish a system of screw threads appears to be the so-called "ornamental lathe threads" adopted by the firm of Holtzapffel in Europe. This system was developed for use in the firm's own shops, but was adopted by many other concerns. The threads were designated by letters and numbers; there seems to have been no thought of using a definite number of threads for a unit of length. The letter indicated the diameter, and the number the pitch of the thread. "A1," for example, represented a thread of about 1 inch diameter with 6.58 threads per inch. A "B2" thread was 7/8 inch in diameter, with 8.25 threads per inch. In all, there were twenty-two sizes running from 0.100 to 1 inch in diameter.

The first uniform system worked out in a scientific manner was brought before the Institute of Civil Engineers in England by Sir Joseph Whitworth in 1841. He was a manufacturer in the machinery field, and had found it very in-

convenient in making repairs on engines and other equipment to be obliged to match all kinds of thread forms and pitches. He made an extensive collection of threaded parts from all the principal English shops and determined what represented the average practice with regard to sizes and number of threads per inch. The Whitworth system gradually became the recognized standard in Britain and, to a considerable extent, on the continent of Europe.

Screw Thread Systems Developed in the United States

In the United States, William Sellers, of Philadelphia, went through about the same experience as Whitworth in England, but in establishing a standard practice, he paid more attention to the convenience of manufacturing and tool expense than Whitworth, and hence, he adopted a thread form with a 60-degree included angle (instead of the 55-degree angle of the Whitworth thread) and with a flat crest and root (as compared with the rounded top and root of the Whitworth thread). The Sellers thread form was approved by the Franklin Institute in 1864, and adopted by the United States Navy in 1868, after which it began to be known as the United States Standard Thread. By this name it was identified throughout the world until the National Screw Thread Commission recently changed the name to American National Standard or National Standard. It is difficult to imagine a valid reason for this change.

While many of the leading manufacturers in the mechanical industries adopted the United States Standard Thread, the rank and file of users continued to employ what has been known as the V-thread, which, by common consent, had been standardized in as far as the number of threads per inch for given diameters was concerned; but there was no standard for the pitch diameter. As late as 1900, there were still many more V-thread taps than United States Standard taps in use, and only within the last forty years have manufacturers of taps discontinued making V-thread taps as a regular product.

British Association and International Screw Thread Standards

In 1876, Professor Thury, of Switzerland, started a careful study of the requirements of the clock and watch makers, and developed a Swiss system of small screw threads conforming to metric measurements. This thread has a 47 1/2-degree included angle, with round crests and roots. His work was the basis on which was established the British Association Screw Thread now used for most work under 1/4 inch in diameter in Great Britain.

In 1898, the International Screw Thread Standard was adopted by a convention representing several continental European countries. This system was based on the French metric screw thread system which had been adopted by the French engineering societies in 1894. The International thread form has a 60-degree angle and a flat crest equal to one-eighth the pitch, so that the form is exactly the same as that of the Sellers thread. This system is now used in several European countries. The Whitworth system is still in use in the British Empire, except Canada, where the United States Standard thread system is generally used.

First Tap Manufacturer in the United States

The first factory engaged in tap manufacture of which there is any record in this country was established in West Harwich, on Cape Cod, in 1866, by a naval engineer, Benjamin Bee. He obtained a patent on tap-threading machinery for milling threads with radial relief, and organized a company under the name of the New York Tap & Die Co. The factory was destroyed by fire a few years later and the business was moved to Bridgeport, Conn. However, the business never became successful, and Benjamin Bee's patented machinery was sold to the Morse Twist Drill & Machine Co., of New Bedford, Mass.

About that time, E. A. Goddard, of Essex, Conn., entered the tap-manufacturing business. His machinery was later bought by Wiley & Russell, of Greenfield, Mass. The name of Redfern also appears at this time as a Connecticut manufacturer of taps. Many of the present leading tap manufacturers established their tap-making business during the depression years from 1873 to 1880.

Some Early Tap Manufacturers

James M. Carpenter, of Pawtucket, R. I., was one of the early successful tap manufacturers in this country. He was a machinist and toolmaker with considerable experience in some of the best plants of that day, including the Brown & Sharpe Mfg. Co., which had made its own taps. In 1870, Carpenter established the J. M. Carpenter Tap & Die Co. in Pawtucket, R. I. He continued to direct all the activities of this plant until his death in 1923.

John J. Grant, of Northampton, Mass., deserves considerable credit for his contributions to the thread-cutting tool business. In 1871, he started to manufacture a patented thread-cutting tool in Greenfield, Mass. This is really the first "modern" thread-cutting die on record. In 1872, S. L. Wiley and Charles P. Russell joined with Grant under the firm name of Wiley &

Russell to manufacture the new die, which became known by the trade name "Lightning."

They also added taps, die stocks, and tap wrenches to their line of manufacture, calling the complete outfit a "screw plate." Within two years, the company employed about forty men. In 1874, Wiley and Russell purchased Grant's interest, and the firm became known as the Wiley & Russell Mfg. Co. For some time this concern was the largest tap manufacturer in the business, and remained among the leaders up to the time the Greenfield Tap & Die Corporation was formed, in which organization the Wiley & Russell enterprise was absorbed.

In 1874, two Reece brothers left the Wiley & Russell firm and started to manufacture a new style of round adjustable dies. In 1876, F. E. and F. O. Wells, together with their father Elisha Wells (who probably was the first tap salesman), left Wiley & Russell, and under the name of Wells Brothers, started to manufacture "Little Giant" dies, which later became perhaps the best-known hand thread-cutting tools in the world. Thus, within a few years after Grant took his patented die to Greenfield, that town became the headquarters for threading tools.

It is surprising that after these first successful manufacturers became established, about a dozen more came into the field in a few years, and in a period when business was generally very poor. By 1880, in addition to those mentioned, Card, Morse, Pratt & Whitney, Butterfield, Holroyed, and J. M. King were all in the field. From this it is evident that, from 1870 to 1880, the practice of each manufacturing plant making taps and dies for its own use was generally discontinued in favor of purchasing the taps from firms who specialized in their manufacture.

Development of High-Speed Steel and Ground-Thread Taps

The Winter Brothers Co., of Wrentham, Mass., was started in 1900. This concern was still one of the smallest of the tap manufacturers when high-speed steel came into use, but this small firm did practically all the pioneer work with high-speed steel taps. In their efforts, the Winter brothers were aided by the Cadillac Motor Car Co., which adopted high-speed steel taps for many jobs in its plant.

In 1906, James Hartness of Springfield, Vt., obtained a patent on a ground-thread tap, but nothing was done to develop this patent. It is difficult to determine when thread grinding first appears as a mechanical process. Before it was a recognized mechanical operation, some of the thread-gage manufacturers did some very slow thread grinding to correct gages before final lapping. They also ground taps for internal gages, and it is reported that a nut manufacturer corrected the lead and size of large nut taps by using a small grinding attachment on a lathe as far back as 1900.

The first time that tap threads were ground on a commercial basis appears to be in 1914 when the Winter Brothers Co. ground taps for the Cadillac Motor Car Co. It is of interest to note that, at first, this grinding was not for accuracy, but for economy and convenience. At that time, threads in the Cadillac plant were roughed out by machine-tapping 0.010 inch under size and finished by hand-tapping with a standard tap. Roughing taps were sometimes wanted in a hurry. It was found that grinding would quickly make a high-grade special roughing tap out of a standard tap or a tap rejected for size or lead.

The possibilities of grinding for correcting changes due to hardening became quickly evident, and since 1914, ground taps have been made in increasing quantities by the Winter Brothers Co. Later, all other tap manufacturers produced ground taps, the John Bath and the Hanson - Whitney companies specializing in these taps from the first.

* * *

Growth of Aircraft Industry

During the ten years from 1924 to 1933, inclusive, the Consolidated Aircraft Corporation, of San Diego, Calif., according to a statement by the company's president, Major R. H. Fleet, delivered somewhat over $18,000,000 worth of planes. At the present time, the company is delivering, each month, approximately the same dollar value in airplanes as was delivered during the entire ten-year period mentioned. The company opened its San Diego plant in 1935 with 311 workers; in July of this year the number of employes had increased to 11,000; right now, the total has reached 28,000. The two Consolidated Aircraft plants in San Diego cover an area of 74 acres. In addition, 51 acres of paved yard are used for outdoor assembly.

* * *

"Strikes as Usual"

The "strikes as usual" policy in effect in this country, notwithstanding the fact that the nation needs to exert every effort to meet the challenge of predatory nations, resulted in a loss of over 9,800,000 man-hours on defense work during the four weeks ending November 21. These figures apply only to thirteen major strikes in plants engaged on national defense orders; figures covering all defense strikes are not available.

It is Easy to Spend Public Money

The testimony of President George S. Benson of Harding College, Searcy, Ark., before the House and Senate committees on government expenditures contains some interesting information. Harding College is an accredited four-year institution of higher learning, having no state subsidy and no private endowment. It has 500 students. Mr. Benson, in his testimony, stated that for the money which the Government spends on one CCC young man — $1025 a year—he could put four boys through Harding College, provided the student works one hour a day at remunerative work; and, as the *World-Telegram* says, the chances are that the boy who completes a course at Harding College under so practical and economically minded an educator as Mr. Benson, will be better equipped than a CCC graduate to compete in the everyday struggle for a living. At least, the record so indicates. In its seventeen years of existence, Harding College has been able to find a job for every one of its graduates.

* * *

Standardized Welded Hull Design

A new type of cargo ship that has undergone exhaustive tests by the Navy Department represents an attempt to reduce shipbuilding to real quantity production methods by great simplification of the hull design and by application of arc welding to speed up production. It is said that tests on these ships have proved them so successful that a corporation has been formed to build this type of vessel exclusively. The hull of the ship is arc welded. It has a length of 250 feet, a width of 40 feet, and a depth of 21 feet.

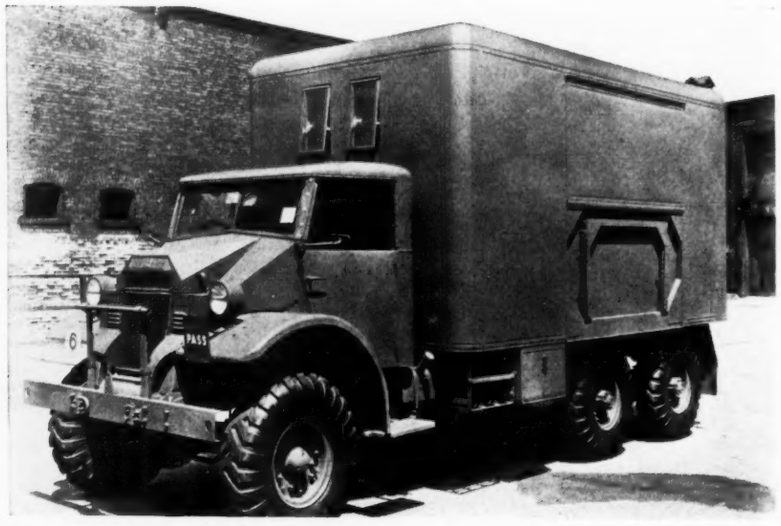
Sub-Contracting in Industry

Sub-contracting has constantly been urged upon manufacturers who have obtained large defense contracts. The object of sub-contracting is twofold—to get the work delivered more quickly and to give the smaller shops an opportunity to help along the Defense Program. As an example of the extent to which sub-contracting has already been carried, it might be mentioned that the Westinghouse Electric & Mfg. Co. now has 300 sub-contractors, mostly small manufacturing firms. Some small companies that would otherwise be forced to suspend business, due to the fact that they could not obtain materials because of priority ratings, now depend upon war sub-contracts to continue operations. One of these was saved from liquidation by a sub-contract giving it enough work to satisfy receivers that operations would be continued at a profit.

* * *

Basic Factors Retarding American War Production

The Farrel-Birmingham Co., Inc., Ansonia, Conn., has published a pamphlet entitled "The Basic Factors Retarding American War Production." This booklet points out three major factors retarding defense production. From official federal reports, the authors find that strikes directly resulted in a loss of 147,000,000 man-hours of effort in the year ending July, 1941. The limitation of the work week to forty hours is suggested as another important cause. The third factor mentioned as retarding output is found in the artificial rise in wage rates, which results in higher costs for defense output.

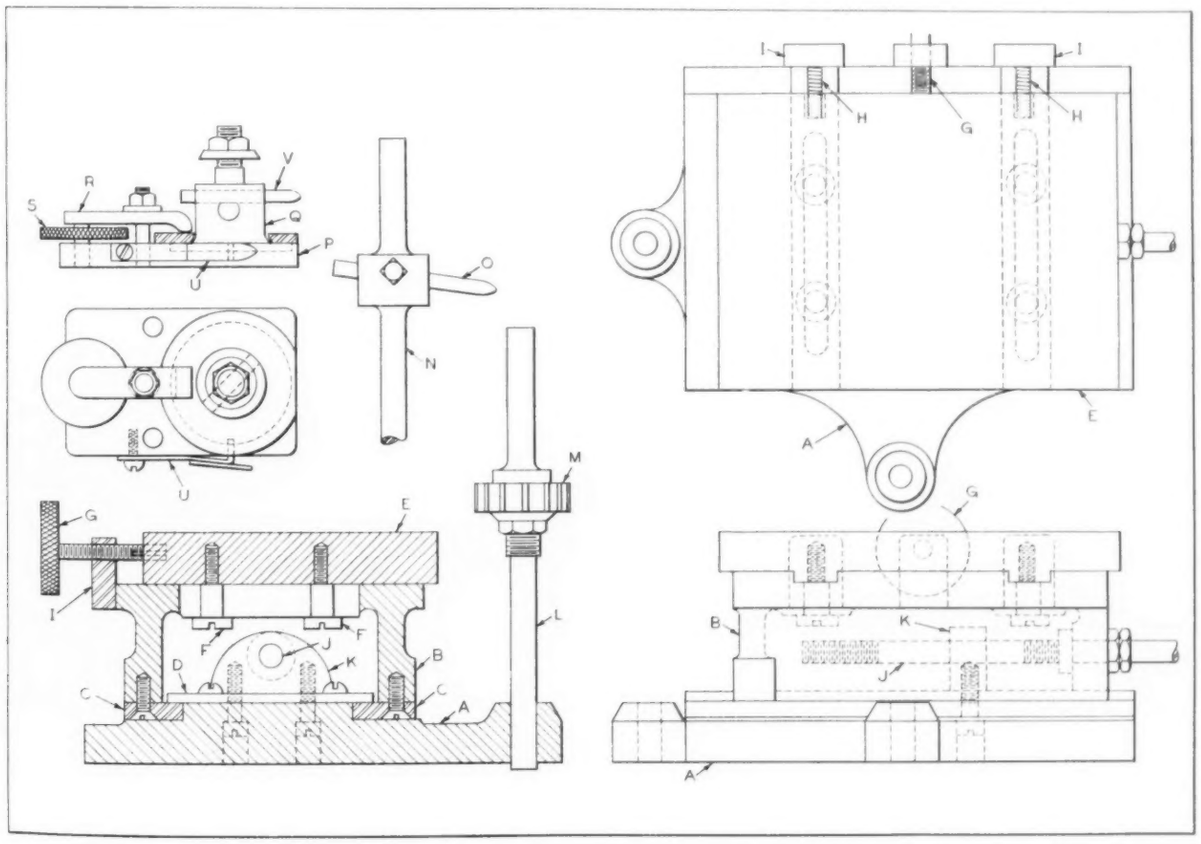


This work shop on wheels has been adopted by the Canadian Government for use with the armed forces. Mounted on a Ford V-8 chassis, this all-steel Lindsay Structure body contains a lathe, drilling machine, and work-bench. Minor damages to anything from a tank to a field kitchen can be repaired with the equipment

Universal Drilling Fixture for Light Work

By J. RODGER HENDERSON

The drilling fixture and accessories shown in the accompanying illustration were made by the writer for use on a light drilling machine employed for turning and shaping small pieces of Catalin. Large quantities of trimmings from sheet stock Catalin, 1/4 inch thick, are trimmed and shaped on this fixture for inlaying geometrical designs on table tops. The fixture can also be used for light metal-machining operations. It is essentially a modification of a compound rest with limited travel of the top table in two direc-



Fixture and Accessories Used on Small Drilling Machine for Light Drilling, Milling, and Turning Operations

tions. Work-holding plates and special clamps are attached to the upper surface for securing the parts during machining operations.

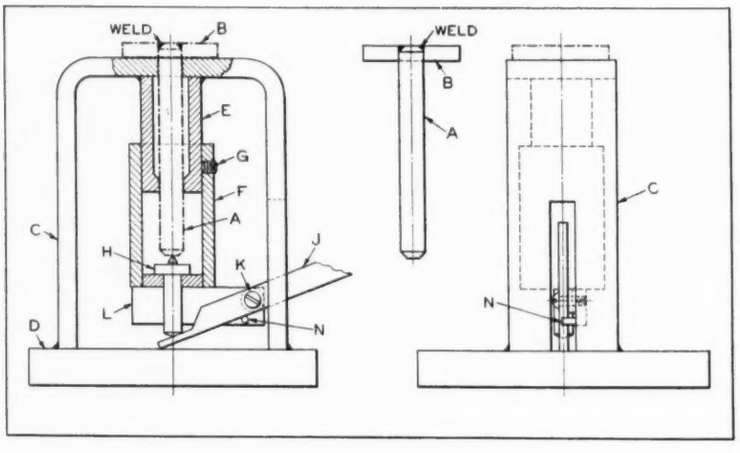
The location of the jig or fixture for most work is determined by placing either one of the two guide holes in base *A* in vertical alignment with the drill spindle or milling cutter spindle *L*. After one of the guide holes has been aligned with the spindle, base *A* is clamped by bolts from underneath the drill table.

The main lower lateral slide *B* which, in this instance, has a movement of 3 inches, is fitted to a machined portion on the base by means of clamping strips *C* fastened to the lower edge of slide *B*, the retaining plate *D* being fitted to the top surface of base *A*. The cross-slide which forms the work-table of the fixture has an adjustment of about 3/4 inch.

Modification of dimensions could, of course, be made to meet specific requirements. The top or upper table is held to the main lateral slide *B* by the four shoulder screws *F*, which permits a free sidewise movement with no lift. Adjustment of the work to the cutting tool is obtained by means of knurled screw *G*, in conjunction with the two compression springs *H*, which are pocketed in both the table and flanges *I*.

The lateral movement of the work-table is obtained by means of feed-screw *J*, operating in nut *K*, which is secured to base *A*, a suitable handle being located on the outer end. One of the tools shown at the right of the sectional view consists of arbor *L*, with the small milling cutter *M*. Various shaped cutters are used on this arbor. Another arbor is shown at *N*, which carries fly cutter *O* that can be set to cut sections having an arc that will fit a predetermined sector.

The attachment shown in the upper left-hand corner of the illustration is used for milling small disks or drilling equidistant holes on a circle. Base *P*, which is secured to table *E* of the main jig, carries turret post *Q* that supports the work by means of clamps on the central stud. With the work disks in position, the turret is held down firmly by clamp *R*, operated by knurled screw *S*, the nose of the clamp pressing on the clamping ring. Twenty-four slots cut in the edge of the circular base on turret *Q* can be used for indexing by means of spring finger *U*, which fits into the slots. As an added convenience, a cutting tool *V* can be inserted in the turret post, as shown.



Fixture for Welding Disk B to Rod A

Fixture for Welding Rod and Disk

By JOSEPH WAITKUS, Wellsville, N. Y.

The welding fixture here illustrated is comparatively simple, but nevertheless important due to the accuracy required. The parts to be welded consist of a rod *A*, both ends of which are chamfered, and a disk *B*, carefully machined and fitted to one end of the rod. The fixture, designed to hold the rod firmly, is provided with means of adjustment for various lengths of rods. Means are also provided for ejecting the assembly after it is welded. This was found desirable because it aided the welder in obtaining a better hold on the disk *B* when extracting the assembly after welding and while it was still hot. The welder, of course, keeps his gloves on all the time when handling this work.

The fixture consists of a bar *C*, bent into a U-shape and welded to the baseplate *D*. The centering tube *E* is welded to bar *C*, and adjusting tube *F* is fitted to the centering tube, upon which it slides freely. The stud-screw *G* serves to hold the adjusting tube in place after the proper depth is determined. The ejector stud *H* has a conical center point to insure that the depth measurement is not affected by a piece of weld "spatter" or dirt. It rests on lever *J*, which is pivoted on a screw *K* in plate *L*, welded to the adjusting tube *F*. A washer is placed between plate *L* and lever *J*.

A pin *N*, fastened to plate *L*, serves as a limit stop for lever *J* which passes through a slot in bar *C*. In order to obtain proper alignment of disk *B* and rod *A*, the surface of bar *C* where the disk rests is machined and properly aligned with the bore in the centering tube *E*. The operation of the fixture is simple, it only being necessary to insert rod *A*, place disk *B* over the end of the rod, weld the members into a unit, and, finally, eject the assembled work.

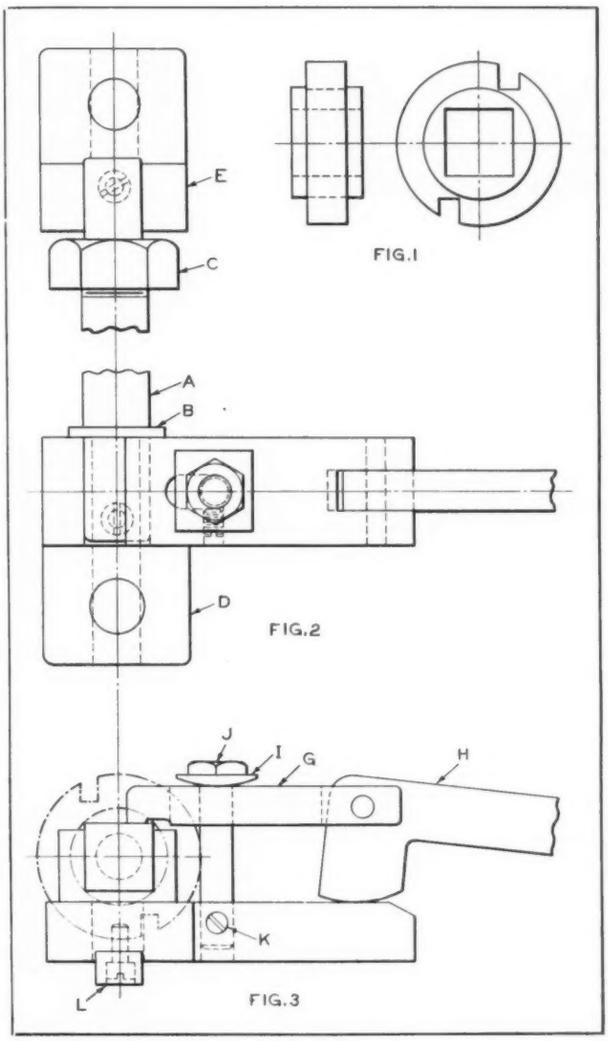


Fig. 1. Piece with Slots Milled in the Periphery Fig. 2. Plan View of Indexing Fixture Used in Milling Slots in the Piece Shown in Fig. 1. Fig. 3. End View of Fixture Shown in Fig. 2

Index Fixture for Slotting Operations

By GEORGE WILSON, Mankato, Minn.

Figs. 2 and 3 show a simple, quick-acting fixture designed for use in slotting the piece shown in Fig. 1. The two slots in the periphery of this piece were originally produced by milling, with the work held on an indexing head.

The arbor *A*, Fig. 2, is a snug fit in the square broached hole in the work. Seven of these pieces are clamped on the arbor for the slot-milling operation by means of a nut *C*, which exerts a clamping pressure against the shoulder *B* on arbor *A*.

The squared end of the arbor is a sliding fit in the slot in head *D*. The other end of the arbor is turned down below the threads and is a close fit in a slot in head *E*. The bottom of this slot has a radius to fit the end of the arbor.

The squared end of the arbor is clamped down in head *D* by the arm *G* actuated by the cam lever *H*, arm *G* being pivoted on the rocker washer *I* of the fulcrum stud *J*. A slot in arm *G* for the stud *J* enables the arm to be retracted to facilitate the removal of arbor *A*. A set-screw *K* maintains the adjustment of stud *J*.

The head of stud *J* is made low to clear the arbor of the cutter used to mill the slots. The cut is started from the clamped end. Aligning blocks *L* are made to fit the slot in the milling machine table. Two arbors are used, one being loaded while the other is in the fixture.

* * *

Mammoth Aircraft Plant Completely Air-Conditioned

The Douglas Aircraft Co., Inc., Long Beach, Calif., has built a windowless factory having approximately 1,400,000 square feet of floor area in the eleven buildings that constitute the plant. It is air-conditioned throughout, having sixty-eight separate air-conditioning plants, with a total of 4026 tons of refrigeration. The air-conditioning installation alone cost well over $1,000,000, the cost of the total plant being about $12,000,000.

One of the interesting features is that the entire plant—including the heating, ventilating, and air-conditioning systems—is designed to make it as safe from bombing attacks as modern engineering ingenuity can contrive. The keynote of the design is decentralization. Thus the manufacturing, storage, and administrative activities are housed in eleven widely separated structures. The heating is decentralized, steam being generated in more than a score of boiler rooms; and the air-conditioning, installed by the York Ice Machinery Co. and the Westinghouse Electric & Mfg. Co., is equally decentralized, being, as mentioned, composed of sixty-eight separate systems.

The air-conditioning system is designed to cool the buildings to 80 degrees F. and 48 per cent relative humidity in the factories, and to 78 degrees F. and 50 per cent relative humidity in the office and cafeteria buildings.

Another feature of the design is the elaborate "blackout" arrangements. The buildings are completely windowless, not having even skylights. Light traps provided at all entrances render the plant invisible from the air at night. Double light-proof doors protect the openings through which railroad cars enter the building. To make the buildings less visible by day, the roofs are flat-topped, offer no light-reflecting surfaces, and are colored to match the paving surrounding the buildings and to blend into the landscape.

Adequate Lighting in Industrial Plants

Some of the Important Points to be Taken into Consideration when Selecting Industrial Lighting Equipment

By W. H. KAHLER
Westinghouse Lighting Division
Cleveland, Ohio

THE country's industrial facilities cannot meet defense demands by working only one shift. Many workers are going to work as the sun sets and returning home before dawn. These people depend entirely on the artificial lighting provided for them to do their work—to read drawings, specifications, tags, or markings of any kind; to handle their tools; to read micrometers; to make precision measurements. Hence, the importance of lighting.

In speaking of lighting, we mean both natural and artificial. However, even with the best window and skylight designs, natural light is adequate during only a part of the daylight hours. Therefore, we must resort to artificial illumination to obtain adequate seeing conditions throughout the entire working day.

Visibility the Prime Requisite

Lighting in industry has one primary function—that is to produce visibility. The seeing conditions should be designed to produce a practical maximum visibility, to prevent eye-strain and to minimize physical fatigue. The term "seeing conditions" includes not only lighting, but the size and form of the object, brightness contrast of the object against its background, and the brightness of the surroundings. Large objects are easier to see than small details. Therefore, if it is necessary to work with fine detail, the amount of light must be increased.

Contrast is important. A dark object is easier to see against a light background than against a dark one. For example, black print on gray paper with an 8 per cent reflection factor requires ten times as much light as would be necessary if the background were white with a reflection factor of 80 per cent.

It is sometimes possible to improve the visibility of industrial seeing tasks by increasing the contrast, but more often contrasts and size of object are determined by the article being manufactured. Therefore, the only remaining controllable factor is lighting. Better lighting can be used to increase visibility and the apparent size of detail.

What is adequate lighting? This question is easy to answer generally, but to define adequate lighting for any one seeing task may involve a detailed study. In general terms, proper illumination design consists of two components, quantity and quality. Both are equally important when maximum visibility of a detailed task is involved. The advantages gained by proper illumination are indicated in Fig. 1.

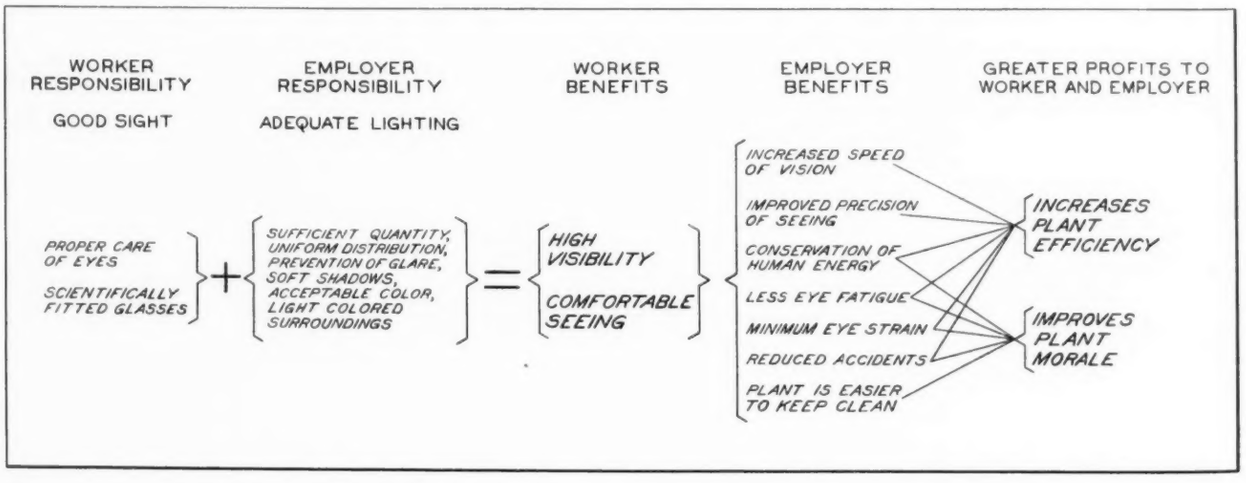


Fig. 1. Chart Indicating the Advantages to be Gained by Proper Illumination

Table 1. Recommended Minimum Standards of Illumination for Industrial Interiors

Condensed from "Recommended Minimum Standards of Illumination" Published by the Illuminating Engineering Society. Complete Data for Specialized Industries may be Obtained from the Illuminating Engineering Society, 51 Madison Ave., New York City

Location or Type of Work to be Illuminated	Min. Footcandles Measured on Work*
Aisles, Stairways, Passageways	5
Assembly:	
Rough	10
Medium	20
Fine	50–100
Extra Fine	100–200
Automobile Manufacturing:	
Assembly Line	50–100
Frame Assembly	20
Body Manufacturing:	
Parts	20
Assembly	20
Finishing and Inspecting	100–200
Forge Shops and Welding	10
Foundry:	
Charging Floor, Tumbling, Cleaning, Pouring, and Shaking Out	5
Rough Molding and Core Making	10
Fine Molding and Core Making	20
Inspection:	
Rough	10
Medium	20
Fine	50–100
Extra Fine	100–200
Locker Rooms	10
Machine Shops:	
Rough Bench and Machine Work	20
Medium Bench and Machine Work, Ordinary Automatic Machines, Rough Grinding, Medium Buffing, and Polishing	30
Fine Bench and Machine Work, Fine Automatic Machines, Medium Grinding, Fine Buffing, and Polishing	100
Extra Fine Bench and Machine Work, Grinding Fine Work	200
Paint Shops:	
Dipping, Spraying, Firing, Rubbing, Ordinary Hand Painting and Finishing; Stencil, Art, and Special Spraying	20
Fine Hand Painting and Finishing	50
Extra Fine Hand Painting and Finishing (Automobile Bodies, Piano Cases, etc.)	100–200
Plating	10
Polishing and Burnishing	20
Power Plants, Engine Room, Boilers:	
Boilers, Coal and Ash Handling, Storage Battery Rooms	5
Auxiliary Equipment, Oil Switches and Transformers, Engines, Generators, Blowers, Compressors	20
Switchboards	30
Receiving and Shipping	10
Sheet Metal Work:	
Miscellaneous Machines, Punches, Presses, Shears, Stamps, Welders, Spinning, Medium Bench Work	20†
Steel and Iron Manufacturing:	
Billet, Blooming, Sheet Bar, Skelp, and Slabbing Mills	10
Boiler Room, Power House, Foundry, and Furnace Rooms	10
Hot Sheet and Hot Strip Mills, Cold Strip, Pipe, Rail, Rod, Tube, Universal Plate, and Wire Drawing	10†
Sheared and Merchant Plate Mills	20
Tin Plate Mills	
Hot Strip Rolling and Tinning	10
Cold Strip Rolling	20
Inspection	
Black Plate	30
Bloom and Billet Chipping	30
Tin Plate and Other Bright Surfaces	50‡
Machine Shops and Maintenance	
Rough Bench and Machine Work	20
Medium Bench and Machine Work	30
Fine Work (Buffing, Polishing, etc.)	100
Extra Fine Work	200
Blacksmith Shop	10
Laboratories (Chemical and Physical), Carpenter and Pattern Shops	30
Storage	2
Store and Stock Rooms:	
Rough Bulky Material	5
Medium or Fine Material Requiring Care	10
Structural Steel Fabrication	10
Testing:	
Rough	20
Fine	30
Extra Fine Instruments, Scales, etc.	100
Toilets and Wash Rooms	10
Warehouse	5
Woodworking:	
Rough Sawing and Bench Work	10
Sizing, Planing, Rough Sanding, Medium Machine and Bench Work, Veneering	20
Fine Bench and Machine Work, Fine Sanding and Finishing	50

*These values should be provided on the work regardless of whether it is in a horizontal, vertical, or oblique plane. These are recommended "in service" values.

†In these areas many of the machines require one or more supplementary lighting units mounted on them, in order to direct the light effectively toward the working points.

‡Large-area light sources of low brightness and good diffusion are necessary for the inspection of shiny or polished work surfaces or parts.

Fig. 2. An Example of Improper Lighting, where the Visibility of the Worker is Reduced by the Direct Glare Produced by an Unshielded Lamp

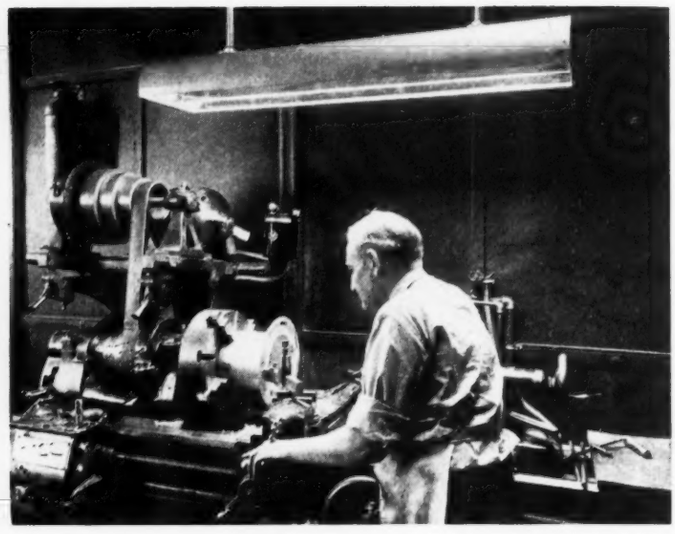


Fig. 3. Well-diffused High-intensity Illumination Requiring No More Wattage than the Lamp in Fig. 2. Luminaire is 4 Feet Long, and Contains Two 40-watt White Fluorescent Lamps

The amount of light, or foot-candles of illumination, necessary for high visibility of an object depends on (1) size of the object; (2) color and reflectivity of the object; (3) contrast of the object with its background; and (4) time available to see the object. Therefore, the required number of foot-candles increases as the seeing task becomes more severe. Table 1 gives the minimum standards of illumination that are recommended by the Illuminating Engineering Society.

The term "quality of lighting" is less tangible than quantity, or foot-candles. It includes the factors of glare, distribution of light, shadows, and color. Glare may be direct or reflected. The most common causes of direct glare are unshielded light sources. A bare lamp in the field of view (Fig. 2) may reduce the visibility 50 per cent or more, thus considerably hindering a worker at his job. All light sources should be properly shielded, as shown in Fig. 3.

Reflected glare is caused by a polished surface reflecting a bright light source. Polished machine parts or tools, and other reflecting metal surfaces, cause glare in many factories. To eliminate this condition, the light source should be enclosed by a diffusing medium or bright lamps should be replaced by low brightness sources in proper reflectors.

Another form of glare common in a factory is a brightly lighted work spot in dark surroundings. The eyes will be uncomfortable and strained because they cannot become adjusted to both light and darkness. To prevent this condition, the lighting system should produce a uniform distribution of light over the entire area. Uniform illumination also leads to the most economical use of floor space, as machines and benches can be located anywhere, and the seeing conditions will be equally good.

Another common hindrance to efficient seeing is shadow. It is very difficult to see any detail in a shadow, because the eye becomes adjusted to the higher brightness of surfaces not in shadow. Shadows are caused by (1) improper location of luminaires; (2) too wide a spacing of luminaires; and (3) luminaires that are too concentrating. It is good practice to install reflectors in a spacing no greater than their mounting height. If benches or machines are located against a wall, reflectors should be mounted within from 2 to 4 feet of the wall to eliminate shadows and provide a sufficient quantity of light adjacent to the wall.

Color of light versus visibility has been the subject of considerable controversy in the lighting industry. Carefully controlled laboratory tests have shown that color has little effect on actual visibility. However, color does have a definite psychological effect that is worth considering. A light that is strong in blue or green is said to have a "cool" color and many workers prefer it because it appears to be more comfortable for certain visual tasks. Mercury, combination mercury and incandescent, or daylight fluorescent lamps will produce a cool quality. Sources strong in orange and red produce a "warm" color; the most common example of this is the incandescent lamp.

In many cases where high-intensity lighting is required (50 to 100 foot-candles), the cool colors are more acceptable, because the workers do not get the psychological effect of excessive heat from the lighting. At lower levels (under

50 foot-candles), objects seem brighter under a light of warm color. The white fluorescent lamp produces a color warmer than the daylight fluorescent or mercury lamp, but "cooler" than incandescent lamps and is usually very acceptable for illumination levels above 20 foot-candles.

Where color matching or color discrimination is a production problem, the color of the lighting is of vital significance. Many inspection operations depend upon color discrimination, and natural north skylight has been most universally accepted as a standard. This color quality can only be satisfactorily duplicated with incandescent lamps and carefully designed blue filters. In many cases, however, the daylight fluorescent lamp has been found entirely satisfactory.

It is relatively simple to say what proper lighting should be, but to actually produce this condition may be more difficult. Often certain compromises must be made between the theoretically proper lighting method and the practical means of doing the job. It is the responsibility of a lighting specialist to guide the "buyer of visibility" in obtaining the best practical solution to his lighting problem.

There are three common light sources used in industrial lighting today: (1) Incandescent; (2) fluorescent; and (3) mercury lamps. In choosing from these, we should consider quality of lighting, initial and operating cost, and adaptability of source to the particular application being considered.

The incandescent lamp has been most universally used, but the fluorescent lamp is now taking its place for most applications where detailed seeing is involved.

Fluorescent lighting is particularly well suited for metal-working shops, intricate assembly operations, and locations where a superior quality of light is required for precision production. The reason for the immediate acceptance of this new source of light is the many advantages it offers, such as high efficiency, low brightness, minimum heat radiation, desirable color quality, and long life. The incandescent lamp is still most popular for applications not requiring high quality or quantity, such as storage buildings and outdoor lighting.

The main advantages of the mercury lamp are high efficiency and long life. This lamp is about twice as efficient as large incandescent lamps, and has a life of 3000 hours. Mercury lamps are best suited for high mounting heights

Fig. 4. Typical Installation of Widespread Aluminum Reflectors Mounted 26 Feet High. Mercury and Incandescent Units are Arranged on a Staggered Lay-out

Table 2. Chart for Selecting Luminaires

A = Excellent; B = Good; C = Fair; D = Poor

Type of Luminaire	Mounting Height, Range in Feet*	Quality of Light					Approximate Efficiency, Per Cent	Maintenance
		Direct Glare	Reflected Glare	Shadows	Light on Vertical Surfaces	Visibility of Micrometer Scales, etc.		
For Incandescent and Mercury Lamps								
RLM Dome	9 to 18	D	D	C	B	D	78	B
RLM Silvered-Bowl Diffuser	12 to 22	B	C	B	C	D	65–70	C
Industrial Diffuser	8 to 18	B	B	A	A	C	65	D
Widespread High-Bay Reflector	15 to 30	C	C	B	B	D	80	B
Concentrating High-Bay Reflector	30 to 60	C	C	C	C	D	80	B
For Fluorescent Lamps								
RLM Porcelain Reflector	8 to 18	B	A	A	A	C	78	B
Continuous-Strip Porcelain Reflector	10 to 18	B	A	A	A	A	75	B

*These mounting heights represent the normal range of use, but are not intended as definite limits. In very large buildings, the wide-spread luminaires can be used at higher mounting heights and will provide high utilization of light.

(above 16 feet) in steel mills, foundries, and allied metal-working industries. Mercury and incandescent lamps are often used in combination on a staggered lay-out (Fig. 4) to provide a desirable color quality of light. The mounting height for a staggered lay-out should be at least 25 feet to permit a uniform mixing of the light from the two sources. At lower mounting heights, mercury and incandescent lamps may be mixed in combination luminaires.

Selection of Luminaires

No one light source or type of luminaire is suitable for every application, but an intelligent survey of the sources and equipment available will lead to a choice that is best for the particular application. The selection of lighting should be based upon sound engineering principles, which include consideration of all the factors involved. The following factors could be the basis of an engineering specification that would insure a satisfactory lighting system.

1. Quantity and quality of lighting shall be adequate for the visual tasks involved, and shall be in accordance with the latest Illuminating Engineering Society's recommendations.

2. The system shall be economical, considering fixed charges (depreciation, interest, taxes, insurance), lamp replacements, cleaning, and power. Low cost, however, shall not jeopardize the required quantity and quality of light necessary to maintain adequate seeing conditions.

3. Luminaires shall have maximum efficiency, and shall be durable, easy to install, and easy to maintain.

4. Proper provision shall be made for the economical, easy, and regular maintenance of luminaires.

The luminaires listed in Table 2 are the standard types used for general industrial lighting. One or more of these units can be used to solve practically any general lighting problem in industry. The table has been prepared as a guide in comparing the various characteristics of these standard types of luminaires.

The RLM dome reflector consists of a dome-shaped porcelain-enameled steel reflector and a socket assembly. It is the cheapest type, and provides the poorest quality of lighting. It is only recommended where detailed seeing is not involved. White bowl lamps should be used in these reflectors to reduce direct and reflected glare.

The RLM silvered-bowl diffuser is designed for use only with the silvered-bowl lamp. It also is a dome-shaped, porcelain-enameled reflector, but is equipped with a semi-specular metal reflector that directs the indirect component from the silvered-bowl lamp to the working plane. By using the silvered-bowl lamp, bare lamp glare is completely eliminated.

The industrial diffuser consists of a porcelain-enameled reflector, a diffusing globe or bowl, and a socket assembly. It is available for incandescent, mercury, or mercury and incan-

descent lamps combined. The diffusing globe reduces bare lamp brightness, and thus minimizes direct and reflected glare. These units are especially suitable for use in machine shops and other locations where a high quality of lighting is required.

The RLM silvered-bowl diffuser and the Glassteel diffuser both produce high-quality illumination. The former is more efficient and is easier to maintain. The Glassteel diffuser, however, will furnish better diffusion, fewer shadows, and higher foot-candles on vertical surfaces.

High-bay reflectors are designed for higher mounting heights, and are available for mercury and incandescent lamps. They are usually a deep bowl shape, and may have a widespread or concentrating distribution. These units may be porcelain-enameled steel, silvered glass, prismatic glass, or aluminum. The aluminum reflector, however, is not being used extensively at present due to a shortage of that material created by the national emergency.

Porcelain-enameled reflectors, due to their light reflecting characteristics, can only be made in wide distribution types. They are suitable for low and medium mounting heights.

Silvered and prismatic glass reflectors are manufactured with wide or concentrating distributions. The concentrating types are suitable for mounting heights of 40 to 60 feet, such as are often encountered in steel mills, foundries, large press shops, etc.

High-mounted reflectors are usually difficult to reach, so they should be designed to require minimum maintenance attention. To prevent dirt from accumulating rapidly on the reflecting surfaces, all reflectors should be equipped with dust-tight covers. The glass in these covers should be of the clear, impact resisting type to prevent accidents that might be caused by falling pieces of broken glass.

Industrial fluorescent luminaires are available with porcelain-enameled reflectors for 40- and 100-watt Mazda F lamps and 85-watt rectified fluorescent lamps. The porcelain-enameled re-

Fig. 5. Precision Machine Tool Jobs Require Both Quantity and Quality Lighting. Both Requirements are Met by Using Fluorescent Luminaires to Form Continuous Lines of Light Supplying 45 Foot-candles at the Working Level

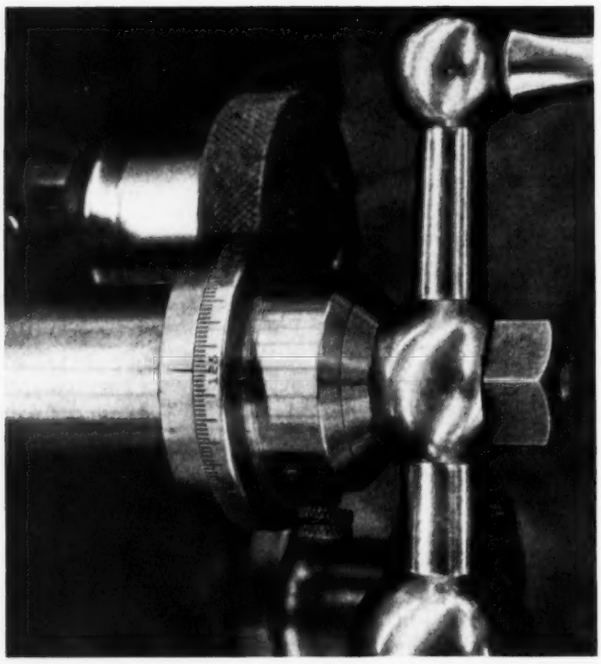


Fig. 6. Typical Cross-feed Micrometer Collar on a Lathe as Illuminated by the Continuous Strip Lighting Shown in Fig. 5. Note the Distinct Visibility of the Graduations

flector gives a well diffused light, and vertical surfaces are well illuminated. These units will provide maximum efficiency at low mounting heights in small or narrow rooms, but in very large open areas, porcelain reflectors will provide high efficiency at mounting heights of 20, 30, or even 40 feet.

Since the fluorescent lamp is a long light source, it is easily adapted to trough or continuous strip lighting (Fig. 5). The lighting troughs are usually made up in sections, and reflectors may be of either the open- or closed-end types. Each reflector takes two or three 40-watt lamps. The main advantages of this new lighting method are reduced installation cost and extremely high visibility, which is important where micrometers, steel scales, gages, and micrometer collars on machines have to be read. Fig. 6 illustrates the high visibility obtainable with this light source.

In addition to the general illumination, it is often necessary and economical to build up higher levels of lighting on the work by supplementary luminaires. The higher levels of general lighting of today eliminate supplementary lighting to a great extent, but in many cases, general lighting will never produce the proper seeing conditions on intricate operations. Fluorescent luminaires will usually meet the requirements to best advantage because of the low brightness and minimum heat-radiation of the lamp.

The Importance of Paint in Providing Good Light

As has been pointed out, the quality of lighting is determined by the type of luminaire. There is one more factor that must be considered; this is the reflectivity of walls, ceilings, machines, and other objects in the room. Light-colored surfaces provide maximum efficiency of lighting, best diffusion, reduction of glare, and a more cheerful environment in which to work. Even with the best lighting equipment, a room with dirty walls and ceiling will appear dingy. Also, if the work is brightly lighted and the surroundings are dark, the worker is subjected to fatiguing eye-strain because the eye has to constantly adapt itself from light to darkness as the worker glances around the room.

A mill-white or aluminum finish is usually used for ceiling and walls, but other light tints may be equally effective and often give a more pleasing appearance to a shop. The lower portion of the walls should be of a darker color, because light colors close to the floor will soil quickly. The color and brightness of machines are also important in providing better seeing conditions. Recent experiments have shown that visibility can be considerably improved by painting the working area of a machine light buff and the body medium gray.

Relation between Light and Sight

The industrial seeing problem may be summarized by the formula (as indicated in Fig. 1): Good Sight + Adequate Lighting = High Visibility and Comfortable Seeing. The first factor, good sight, is a worker responsibility. Sight is priceless, and most sight defects can be easily corrected if a competent eye specialist is consulted in the beginning. Employes should take care of their eyes, and employers should sponsor periodic check-ups on sight.

The second factor, adequate lighting, is strictly an employer responsibility and he, also, should make periodic check-ups on his "tools for seeing"—the lighting equipment. Not only is lighting a help to better sight, but through better seeing, there will be a dollars-and-cents return to the employer, as a result of increased production, less spoilage, fewer accidents, and improved plant morale.

* * *

In an English war material plant, the box in which spoilt pieces and tools broken through carelessness are thrown carries this inscription on its side: "This is your contribution to Germany's war effort. Hitler thanks you."

Handling War Material Sub-Contracts Efficiently

Considerable Experience with Contracts for Making Highly Specialized Equipment has Aided the American Machine & Foundry Co. in Shifting from Peacetime to Defense Activities

By HOLBROOK L. HORTON

CAUGHT up in the growing tide of national defense effort, individuals and businesses alike are being swept into new channels of activity. Many manufacturers, comfortably engaged in familiar work, have been suddenly called upon to make strenuous adjustments. Not only are they facing the task of manufacturing equipment or parts quite foreign to their customary line, but also many of them must solve the problem of establishing a satisfactory subcontract relationship with other manufacturers.

Although the large volume of non-defense work being "starved out" due to restrictions in the supply of materials makes war material contracts a welcome source of revenue, it behooves those seeking such contracts for the first time to exercise extreme caution. Financial loss or even inability to complete the contract may result if the requirements of the product to be made are not adequately met by the facilities and resources which the manufacturer has available. Of course, a change to a different line nearly always brings with it unsuspected difficulties, such as may be experienced in processing a new and unfamiliar material. These are to be expected; but to such normal hazards the requirements of war material contracts frequently add the onerous burden of extremely close tolerances and the most minute and thorough inspection.

The American Machine & Foundry Co., Brooklyn, N. Y., had, fortunately, considerable experience in handling contract work of a variety of kinds previous to the start of the present defense effort. This company, established in 1900, was originally engaged in the design and manufacture of tobacco and cigarette machinery, and later added bakery machinery to its line. Besides this equipment, it also made many products for other companies.

Up to the time that the Defense Program got into full swing, this company had manufactured some sixty different kinds of equipment, including such widely diversified and highly specialized products as cigar and cigarette making machines and wrapping machines, cigarette packing machines, cigar cellophaning machines, bread wrapping machines, dough-mixing machines, necktie and ornamental stitching machines, etc. It had, therefore, considerable experience in solving problems peculiar to the manufacture of any highly specialized piece of equipment. It also had the experience of seeking out contracts and analyzing potential jobs from the standpoint of its ability to handle them. The experience of this company in changing from peacetime to war production should be helpful to other concerns embarking upon a similar program. Some of the details of this experience will, therefore, be touched upon in this article.

When the National Defense Program got under way, one of the first defense jobs obtained by this company was a contract with the Sperry Gyroscope Co., Inc., for large numbers of intricate parts for seachlights. This was a forerunner of other contracts for parts from the same company. Then, following its initial experience in the manufacture of parts for defense equipment, this company was called upon to make complete machines for other companies.

It may be mentioned here that the American Machine & Foundry Co. had, for some time, provided for initial contact with its customers through contract specialists who were thoroughly familiar with the facilities and skill available in their own organization and the scope of work that it could handle. These contact men were, of course, invaluable when it came to the task of securing suitable defense sub-contracts.

As a result, this company was soon engaged in the manufacture of a number of defense items on a contract basis. At the present time, these include deep-hole boring machines for gun barrels, upsetting machines for tapering cartridge cases, seven-spindle automatic screw machines, parts of steering mechanisms for naval vessels, trunnion arms and parts for an anti-aircraft searchlight, various parts for milling machines,

and a number of highly specialized parts for aircraft use. Each of these jobs brought with it problems that were similar to those which the company had previously solved during its peacetime activities, as well as problems peculiar to itself.

Two-Shift Work Week Found to be Satisfactory

One of the basic problems that had to be faced was a large increase in the volume of work coupled with a growing shortage of labor. This resulted in a gradually lengthening work week, which was increased from forty to fifty, to fifty-eight, and finally to sixty-five and a half hours. In addition to the day shift, a night shift was added. At the present time, the night and day shifts are in the plant twelve hours each for five days a week (with one-half hour allowed for lunch), and eight hours each on Saturday. This arrangement has its advantages, as well as its disadvantages. One of the advantages is that, with the night and day shifts meeting twice each day, both foremen and operators are able to pass on any suggestions, questions, or advice relating to the work in process directly to those taking over.

One of the difficulties that had to be overcome was the proper maintenance of the machines, which, from a schedule of eight hours a day, were stepped up to operating around the clock. In addition to this greatly increased use, higher speeds were introduced, as the installation of cemented-carbide tools became extensive, and this, too, presented maintenance problems.

The number of men engaged in keeping the equipment in working order was increased from three to sixteen. During the night shift, maintenance was devoted solely to keeping equipment running wherever possible, while during the day shift, machines were withdrawn from service, dismantled, and repairs made, where necessary. In most cases, this was accomplished without any serious disruption, because there were almost always spare machines available in each department as a result of employe absence, due to sickness or other causes.

Large Group Provided for Tool Maintenance

Another group of workers that had to be increased substantially was the tool-keepers and tool-sharpeners. With equipment operating continuously and at higher speeds, the proper maintenance of cutting tools became of prime importance. To handle the greatly increased volume of tools in use, fifty-two men are now needed, as against fifteen previously.

In connection with the use of cutting tools, it is of interest to note that this company developed a method of using cemented-carbide tools particularly suited to some of its older machines. First attempts to use these tools on machines that did not provide the supposedly necessary rigid support, resulted in a high percentage of breakage. After a period of time, experiment showed that rather than holding the cemented-carbide tool close to the cutting point, if support was provided at a considerable distance from it, less breakage occurred. Thus, in some cases, contrary to the usually recommended practice, cemented-carbide tools are being used with supports 9 or 10 inches away from the cutting point.

Naturally, a considerable amount of bending and flexing occurs, but this has not been found to be detrimental. Apparently, the reason for this is that with the tool support at a distance from the cutting point, the maximum stress occurs in the tool-holder. When, however, the tool is supported close to its point, these stresses are concentrated in the cemented-carbide insert; and when such stresses are the result of considerable vibration or shock, a high degree of breakage follows.

Training Provided on the Job with Skilled Worker Supervision

The total number of employes in the American Machine & Foundry Co. has been increased from 800 to close to 1800—more than double. The use of two shifts, however, has permitted these additional men to be absorbed without the necessity of finding added space for them. Although at first it was possible to hire men with considerable experience, as time went on it became more and more necessary to resort to inexperienced help. This brought about the need for some arrangement of providing training and close supervision for inexperienced operators during their early period of employment.

To meet this need, some of the most highly skilled workers were designated as instructors or set-up men. They were each placed in charge of eight or ten new employes and were responsible for instructing them in the setting up and operation of equipment to which these employes were assigned. Each new operator was encouraged to get "on his own" just as soon as he was able. This plan has worked out so well that, in some cases, new employes, have, themselves, been able to act as instructors after one and a half to two years of training and experience.

Added Storage Space was Needed at Many Points throughout the Plant

With twice as many men employed as before and with machines operating approximately three times as long, the flow of raw material

and parts in process was increased considerably. Since the work-day was lengthened, too, this flow could normally be taken care of with the addition of a large number of skids and tote trucks for interdepartmental transportation. However, it was found that whenever anything caused this flow to slow up, the large volume of work being passed along to the points of stoppage resulted in using up every available bit of nearby space for storage. This sudden demand for storage space might be required for anything from rough castings to completed parts. As a result, special racks and expanded facilities for meeting this need were provided at a number of points throughout the plant.

Production Planning Avoids Delays in Flow of Processed Parts

Much of this difficulty was avoided, however, by a group of production planning and control engineers, who laid out the time schedule, material routing schedule, and machine utilization well in advance of the actual beginning of each job. This planning ahead prevented a great deal of congestion in the product flow, which might otherwise have resulted. Thus, it was necessary to avoid bottlenecks due to the need for certain key machines to perform operations on two different jobs going through the plant at the same time.

Another possible source of delay in production flow that had to be anticipated was failure to obtain rough castings from the outside on schedule. It may be said here that, as far as possible, adequate supplies of materials and rough castings have been stored close at hand. Thus, the normal storage space within the plant has been augmented by the use of the plant yard and several outside warehouses.

A great deal of war work has, as many manufacturers now realize, severe requirements as to tolerances and calls for a very strict inspection of the finished product. In the case of the American Machine & Foundry Co., much of the peacetime work required tolerances in the range of one or two thousandths inch. With the advent of war sub-contracts, however, these tolerances were narrowed down to one or two ten-thousandths. The possibilities of spoilage, arguments as to cause, and resulting employe and customer dissatisfaction brought about by such restrictions are not hard to visualize.

Thorough First-Piece Inspection Prevents Excessive Rejections Later

Most of this was avoided by the establishment of a procedure providing for a thorough "first-piece inspection" by both the foreman and inspector. Thus, the first piece that came off the machine was examined, and, if found to be outside of the required limits, the entire operation was carefully checked. The cutting speed, feed, depth of cut, kind of tool, set-up of the machine, and any other possible contributing factors were carefully reviewed to establish the cause and correct the error. In this way, the operator was started on the right path for producing pieces to exact specification at the earliest possible moment.

Many of the war products manufactured by this company require 100 per cent inspection. Such detailed examination may increase the normal cost of manufacture by 50 to 100 per cent, an important factor to be kept in mind when cost estimates are being prepared. A considerable number of inspectors are now employed by this company, and some inspectors for its customers are also working in the plant. Large numbers of gages, surface plates, and other equipment utilized for these inspection operations are needed. Such equipment is still hard to obtain, and the company has been making such pieces as surface plates itself.

The addition of a night shift placed added emphasis on the need for adequate lighting. This was particularly noted in cases where machine ways had to be scraped to a high degree of smoothness. A minimum of 18 to 20 foot-candles of light was found to be necessary, and new fluorescent lighting was installed to provide this.

Procedure Followed in Obtaining and Handling Sub-Contracts

It may be of interest to describe briefly the procedure followed by this company in obtaining and handling sub-contracts. The contract specialist interviews the manufacturer who has work to be "farmed out" and looks over the blueprints or product in question. This man is thoroughly familiar with the various types of work that the plant can handle, and is thus able to reject many jobs that would prove to be too costly or too highly specialized for the company to undertake.

If the job seems to be suitable, a complete set of blueprints is requested, and these are placed in the hands of the estimating department, where an estimate of the cost of manufacture, the amount and character of equipment, the number of workers required, and the possibility of handling the job simultaneously with other jobs already under way are examined.

After approval by the management, a proposal is submitted to the customer, and, if satisfactory, a written contract is drawn up. In addition to the amount to be paid, this contract covers such points as date of delivery, who will

furnish the material, patterns, jigs, and fixtures, etc. With the contract signed, the job then goes to the production planning and control group, which lays out the tool schedule, material routing schedule, and equipment to be utilized.

Job Evaluation Found Valuable for New Work

One of the practices established prior to the Defense Program that is proving to be of considerable value in connection with the defense work is that of job evaluation. Thus, a study of each job from the standpoint of skill required, type of machine utilized, and hazards involved, as well as number of men available who could do that particular job is made. Based on this study, it is possible to establish a rating for new jobs that will insure a more equitable wage rate, as compared with the rates for other jobs of a different character, than could be obtained by any decision based purely upon experience and custom.

* * *

Exports of Industrial Machinery Decline

The exports of industrial machinery during the month of September, the last month for which complete figures are available, amounted to $34,250,000. This is a decline from the value of $41,975,000 reached in August. The exports of machine tools amounted to $14,275,000 in September, a decrease of 16 per cent from the August total. In these exports, lathes represented $3,510,000; milling machines, $3,365,000; grinding machines, $2,090,000; and drilling machines, $720,000. Metal-working machinery other than machine tools was exported to a value of $2,304,000.

* * *

Machine Tools Required in Automobile Manufacture

In an address made before the Army Industrial College at Washington, D. C., by K. T. Keller, president of the Chrysler Corporation, it was mentioned that the corporation has over 15,000 machine tools employed in the manufacture of cars and trucks. Of these, 2500 machine tools are turning machines of different types; 3300, drilling machines; 2100, grinding machines; 1100, gear-cutting machines; 1800, milling machines; 140, sawing and cutting-off machines; 250, forging machines; 1900, power presses; and 2200, miscellaneous specialized machines.

Sound Films for Educating War Workers

A series of sound films have been produced by the U. S. Office of Education, Federal Security Agency, to assist potential and employed industrial war workers more rapidly to learn and more thoroughly to comprehend the instruction being given them in vocational and trade schools throughout the country.

Fifty reels of film, nearly half of which have been completed and the balance of which are in production, comprise the series. These films will be reproduced in the 16-millimeter size and will be available at low cost to war industrial training centers, vocational schools, and plants offering apprentice training. The distribution is in the hands of Castle Films, Inc., 30 Rockefeller Plaza, New York City. Forty of the films deal with machine shop practice, seven of these being devoted to the engine lathe, five to precision measurement, five to vertical boring mill work, five to milling machine work, five to drilling machines of various types, seven to press work, three to shaper work, and the remainder to miscellaneous subjects.

* * *

Labor Union Pledges Itself to Avoid Defense Strikes

Placards have been posted at various points throughout the plant of the American Car & Foundry Co., Berwick, Pa., bearing the inscription "S.W.O.C. Union in This Plant is Pledged Against Strikes." The union initiated this step, showing that the rank and file of labor are anxious to cooperate when it comes to defense production.

The Berwick plant of the American Car & Foundry Co. was the first civilian builder to engage in the manufacture of light combat tanks. The company turns out 400 tanks a month. Early in October, it had completed over 2000 tanks for the U. S. Government. Five hundred of these tanks are now in North Africa.

* * *

Paint Available for Blackout Purposes

A blackout paint for use in darkening windows and skylights of industrial plants, where it would be impracticable to extinguish the lights suddenly at the sound of an air-raid warning, has been developed by the American-Marietta Co., 43 E. Ohio St., Chicago, Ill. The paint, known as Valdura Black-Out, can be sprayed or brushed on windows to prevent all passage of light. The paint can be removed without damage to the glass.

Fig. 1. Performing a Rockwell Hardness Test in an Experimental and Test Laboratory which Controls the Raw Materials Used in a Shipyard

Making Hardness Tests in a Shipyard Testing Laboratory

An experimental and testing laboratory has been established at the Cramp Shipbuilding Co.'s plant in Camden, N. J., for the testing and checking of raw materials and other supplies that are required in the usual run of shipyard work, the examination of any questionable materials, the checking of welded sections of structural members, and so on. In Fig. 1 one of the laboratory men is shown engaged in determining the hardness of a welded section by means of a Rockwell Model R hardness tester, while Fig. 2 shows a Brinell hardness reading being taken on a steel plate by the use of a Detroit testing machine.

* * *

National Vocational Defense Training Program

According to a statement published by John W. Studebaker, U. S. Commissioner of Education, the nation's vocational defense training program, which has been in operation now for over eighteen months, has given, or is now giving, training to 1,776,000 persons in five types of courses. Two of these are given in approximately 10,000 school shops to out-of-school youth. This is considered "feeder" training for those who may later enter intensive defense training courses.

Two other of the five divisions of the training program are fitting young people for skilled and semi-skilled work in aircraft plants, shipyards, war material shops, and other defense industries. This training is being done in more than 1000 vocational schools throughout the country.

Finally, there is the division that trains engineers, chemists, physicists, and production supervisors in courses at 155 colleges and universities.

Congress has appropriated $183,622,000 for defense training from July 1, 1940, to June 30, 1942. Of this, $147,000,000 is being used to pay the salaries of additional teachers for defense training courses and to defray such costs of operation as are in excess of the regular costs of maintaining the vocational schools and shops. About $35,000,000 is being spent to purchase or rent additional equipment and to rent shop space when existing facilities cannot accommodate the defense training classes.

All efforts to provide training for useful work are highly important, and while they are doubly so now that we are at war, the necessity for such training should be thoroughly recognized in time of peace as well. Trained people seldom need depend on the community for relief.

Fig. 2. Taking a Brinell Hardness Reading on Another Type of Machine in the Shipyard's Experimental and Test Laboratory

Special Turret Lathe Tooling Speeds Up Defense Production

By T. J. HUDSON, Chief Tool Designer
The Warner & Swasey Co., Cleveland, Ohio

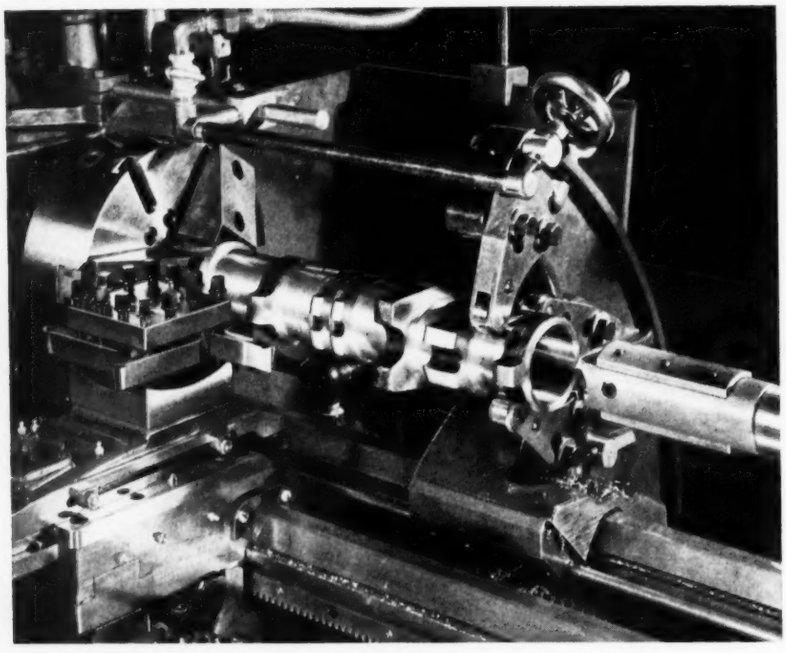
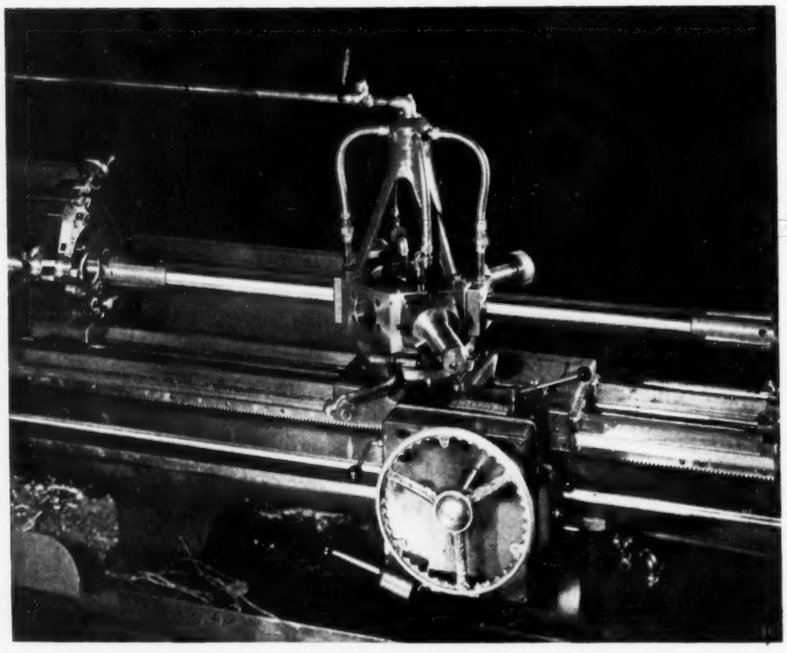


Fig. 1. Boring a Landing Gear Strut with a Boring-bar Having Wooden Pilot Surfaces

Fig. 2. The Tooling Set-up Consists of Two Short and Two Long Boring-bars for Rough- and Finish-boring



RAPIDLY skyrocketing demands for more and more fighting planes have put a premium on ways and means of speeding up all of the operations that go into the manufacture of parts for these planes. The boring of landing gear struts is one of the operations performed at the plant of the Lockheed Hydraulic Brake Co., Ltd., Coventry, England, for which special tool equipment has been devised. An unusual feature of the equipment is the use of wood-packed boring bits.

The tooling set-up was evolved by engineers of the Warner & Swasey Co., Cleveland, Ohio, working in cooperation with Lockheed production men. The set-up consisted of a combination of standard and special tooling applied to a Warner & Swasey 2A long-bed turret lathe. The 32-inch long strut is made from a steel forging, which is to be bored out to a 3 5/8-inch diameter. The universal chuck used, while itself standard equipment, has been provided with a set of extra wide jaws to grip the strut firmly on a finished ground diameter. The opposite end of the strut is supported by a needle-bearing, roller type steadyrest. This provides alignment and support for the cuts.

The wood-packed bits are mounted on flange type boring-bars. Each wood sector is held securely in place by six countersunk-head machine screws. The bit heads are ground on centers, and are provided with double threads to facilitate their removal from the boring-bars. These bit heads, as shown in the accompanying illustrations, make use of ground wooden pilot surfaces as guides for the boring cutters. Several kinds

of wood can be used, such as hard maple, apple, lignum vitae, etc.

On this job, impregnated maple was used. The wood was previously treated by a process in which oil is forced into the wood under considerable pressure. The oil keeps the wood sectors from drying out or cracking, and also acts as a lubricant. The wood is ground so that the diameter of the tool-head over the wooden strips is about 0.005 inch greater than the diameter of the hole to be bored. This insures a tight fit and perfect pilot alignment for the cutters.

bored for the full length of the strut. About 1/32 inch of stock on a side is allowed for the finishing operation.

Following the rough-boring operation, an accurate hole is again bored to a depth of 6 inches to serve as a guide in the finish-boring operation. The boring-bar for boring this second guide hole is equipped with a single-point cutter and also with a chamfering cutter which provides a true center at the end of the short bore for use in grinding the outside diameter of the strut following the turret lathe operations. The

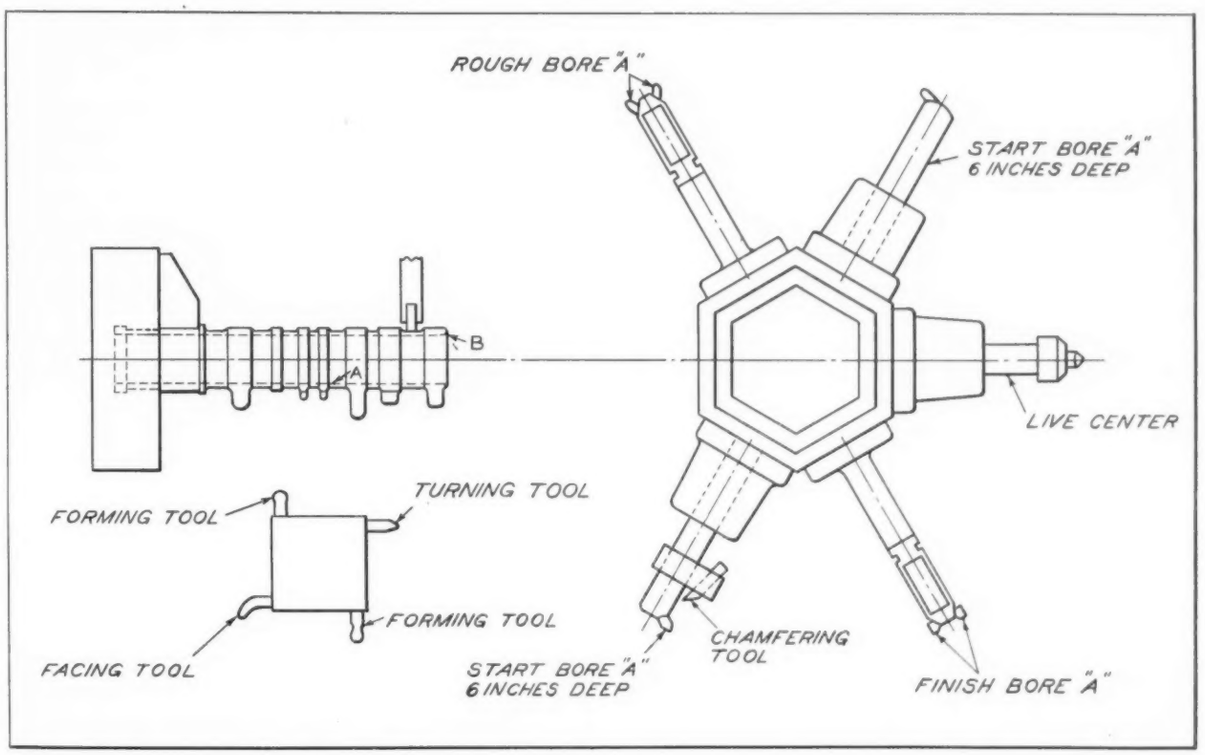


Fig. 3. Tooling Equipment Used in Boring, Turning, and Forming an Airplane Landing Gear Strut

Special attention has been given to chip control. The cutters have been lipped to curl and guide the chip through the rear of the spindle. Improper chip control and breaking of the chips could cause considerable damage to the wooden pilot. The boring-bars and bit heads are provided with oil-holes, so that sufficient coolant is supplied to each cutter. This also assists in washing the chips through the spindle.

The sequence of operations on the strut is as follows: First, the steadyrest support diameter is turned by a tool in the square turret while the work is supported by a live center in the main turret. Then the hole in the strut is bored accurately to a depth of 6 inches with a single-point boring-bar held in the hexagon turret. This provides a starting pilot or guide for the wood-packed bar during the rough-boring operation. In this operation, a straight hole is rough-

final step is the finish-boring of the hole for the full length of the strut.

The forming, facing, and turning operations are performed by tools held in the square turret at the same time as the boring operations.

* * *

The Gear Industry Index

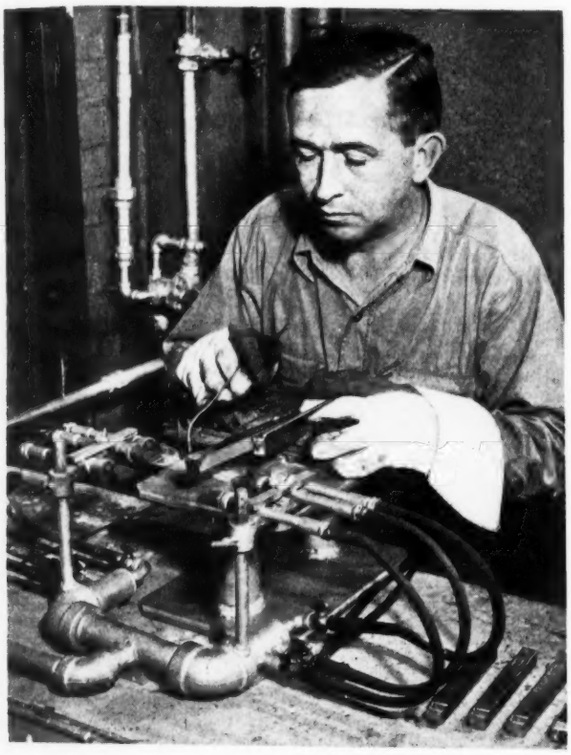
The American Gear Manufacturers Association, 602 Shields Bldg., Wilkinsburg, Pa., reports that industrial gear sales for November, 1941, were 39.3 per cent above November, 1940, but 8.3 per cent below October, 1941. Gear sales for the eleven months ending with November, 1941, were 81.6 per cent above the corresponding period of 1940. This compilation applies to industrial gears only.

Buick Makes Its Own Carbide Tools

HELPING to speed its production of defense items, such as aircraft engines and parts, the Buick Motor Division of General Motors Corporation has eliminated virtually all delays incident to obtaining special tungsten-carbide tools from tool manufacturers by producing such cutting tools in its own plant at Flint, Mich.

Carbide tools are now produced at the Buick plant by brazing standardized sizes of carbide tips to shanks of S A E 1340 steel. While the carbide tips are readily obtained from producers of tungsten carbide, the possibility of delays in obtaining complete tools is avoided. Furthermore, it was found that carbide tools for all classes of work throughout the plant could be produced from eleven different sizes of carbide tips, thus simplifying materially the problem of tip inventory.

The shanks are ground to size on all four sides from hot-rolled stock on water type surface grinders. From here they go to the milling department, where the recess for the tip is milled and the shank is stamped, ready for brazing the tip in place. The tip is polished on the bottom and contact sides with a diamond wheel.



City Gas is Used by Buick in Manufacturing Its Own Cemented-carbide Tools to Speed Defense Production. This is One of the Fastest Brazing Set-ups yet Developed

For brazing, an unusual set-up has been devised which not only permits the use of city gas instead of requiring the usual oxy-acetylene torches or electric furnaces, but is also believed to be one of the fastest tool-brazing set-ups ever developed. The brazing equipment, shown in the accompanying illustration, consists of a fixture having a flat top, on the back of which are attached six fishtail gas tips arranged in such a position that the tool, held in a vise, can be slid into position with three flames on each side. The vise, itself, rests on the flat surface of the fixture. The operator thus has both of his hands free with which to handle the tip and brazing material, in order to assure getting a good braze.

While one tool is becoming heated, the operator prepares another tool for the vise. City gas is used, mixed with air through a venturi tube at each one of the jets. Adjustment of the gas tips regulates the heat.

The tool shank and tip are first cleaned by dipping in carbon tetrachloride. "Handy Flux" and "Easy-Flo No. 3" solder are then applied, the tool is clamped in the vise, and the tip is placed in position in the milled recess and covered with flux to prevent oxidation. The assembly is next slid forward, bringing the tool into the flames in such a manner that the flames come in contact only with the lower part of the tool shank. This avoids direct contact of the flames with the tip and brings the brazing end of the shank up to an even soldering temperature (about 1400 degrees F.).

As the tool heats up and approaches a cherry red, brazing wire (Easy-Flo No. 3, 3/32 inch in diameter) is brought in contact with the rear of the carbide tip and allowed to flow under and around the tip. Using a 3/16-rod with a sharpened point, excess solder and air are removed by moving the tip back and forth in the recess of the tool shank. The operator then brings the fixture back away from the flames, and while holding the tip firmly in the recess, allows it to cool to a point where the brazing material solidifies. This takes place at around 1175 degrees F. for the Easy-Flo solder used. At this point, the operator withdraws the tool, removes the excess flux in hot water, and then proceeds to the next one.

When the tool is cool, it is shot-blasted and goes into temporary stock as a "milled and brazed" tool. From this stock, it is drawn out for finishing the profile of the tip to the final required shape in one of the numerous grinding rooms or service departments located throughout the plant.

Silver Alloy Contacts for Electrical Equipment

The growing demand for silver alloy contacts in the construction of electrical equipment has necessitated the development of new techniques for attaching these alloys to the base metal parts of the switch structures. The electric brazing process is of value in this connection.

An example of this application of the electric brazing process is found in a job performed at the plant of the Gibson Electric Co., Pittsburgh, Pa. This consisted of the brazing of strips and rings of silver-nickel contact materials to heavy copper castings constituting a 4000-ampere disconnect-switch jaw and hinge. Eight strips of Grade A Gibsiloy, 1/64 by 1/2 by 3 1/2 inches, were brazed to the jaw; and four rings 1/64 inch thick, 3 inches outside diameter, and 2 1/8 inches inside diameter were brazed to the hinge. The castings weighed 35 pounds. All of the contacts on each casting had to be brazed at one time; otherwise, the bond of the contacts first brazed might be damaged by the heat required to braze the other contacts.

In carrying out this work, the contacts were placed on the casting, and the casting held between the graphite electrodes of a 50-K.V.A. welding machine, the outer contacts being held by these electrodes. The inner contacts were held between graphite blocks which were pressed against the contact material by means of a wedging clamp. Very little of the current passed through this inner clamping device because it was by-passed by the base of the copper casting itself. Most of the heat was, therefore, generated in the outer electrodes, and the casting had to be brought up to heat slowly in order to give time for as even a distribution of heat as possible, so that the inner contacts could be brazed before the outer contacts tended to melt.

The brazing medium was silver solder, which was applied as a solder flushing on the sheets of silver-nickel from which the contacts were made. The copper blades of the switches on which the jaws and hinges were used were also equipped with silver-nickel contacts.

While, in the example quoted, the contact material was applied to large switch parts, the electric brazing method is equally applicable for attaching contacts to smaller parts, such as contact fingers, springs, screws, studs, etc.

* * *

One thing that we shall learn through the war emergency is that materials and methods considered essential can be replaced if we apply enough thought and imagination.

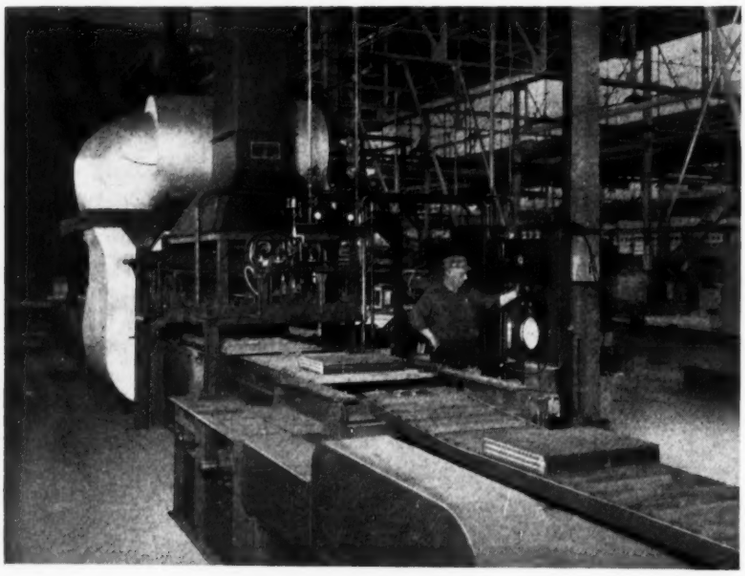
The Defense Savings Payroll Allotment Plan

The Treasury Department, Washington, D. C., has suggested a "Defense Savings Payroll Allotment Plan" through which men and women engaged in industry may regularly set aside a stipulated amount for the buying of Defense Savings Bonds. It is pointed out that company heads can help their country, their employes, and also themselves by instituting such a savings plan in their organizations. The Treasury Department is ready and willing to assist in organizing a systematic and continuous defense bond savings program in any manufacturing plant or business. Further information on this plan can be obtained by addressing the Treasury Department, Section A, 709 Twelfth St., N. W., Washington, D. C.

A Defense Savings Payroll Allotment Plan helps our country in this emergency in many ways: (1) It provides money for vital military equipment; (2) it gives every American the opportunity for financial participation in National Defense; (3) it will reduce the current demand for consumer goods while they are scarce, by storing up wages, thus retarding inflation; (4) by retarding inflation, it will keep down the cost of all goods and materials; including defense materials; (5) by reducing the cost of defense, it will reduce emergency taxes; (6) it will reduce the percentage of defense financing that must be placed with the banks, thus putting our emergency financing on a sounder basis; (7) it will reserve buying power for the post-war purchase of civilian goods to keep our factories running after the war; and (8) it will thereby reduce the ranks of the unemployed during the inevitable period of post-war readjustment.

Complicated Soldering Job Performed Automatically

An automobile radiator requires a countless number of soldered joints. This complicated soldering job is now done automatically instead of by hand. The accompanying illustration shows how the assembly of copper tubes, fins, and solder are placed in position on an electrically operated conveyor in the plant of the Fedders Mfg. Co., Owasso, Mich. First, the assembly passes through a flux spray and then into an oven. The oven-heating cycle is operated in synchronism with the conveyor movement. After a fixed time in the oven, long enough to bring the solder to the flow point, the conveyor starts again and moves the radiator core into a press, where it is held flat and square while an air blast cools and solidifies the solder. This air blast is also controlled automatically in time with the conveyor movement. After the core is sufficiently cool, the press opens and places the core again on the conveyor, which delivers the finished core at the discharge end.



Soldering Automobile Radiators Automatically

* * *

Machine Tool Shipments Rise Sharply

Machine tool shipments rose to a value of $77,200,000 in October, compared with $68,700,000 in September, and $64,300,000 in August. In October, a year ago, the value of the shipments was estimated at $49,000,000. The October shipments are at an annual rate of over $900,000,000, and indicate that the industry will exceed the goal of $750,000,000 for 1941.

Nickel Production Reaches Record Levels

According to a statement by Robert C. Stanley, chairman and president of the International Nickel Co. of Canada, Ltd., world nickel production and consumption in 1941 exceeded all previous records. The joint British, Canadian, and United States war effort required nickel production far beyond anything accomplished in the past. The United States consumed over two-thirds of the world's nickel output in 1941, as contrasted with an average annual consumption of about one-third during recent years.

The steel mills in the United States are consuming approximately 70 per cent of the refined nickel imported into this country. Of the remaining 30 per cent, the foundries take about 7 per cent and the brass mills nearly an equal amount; heat- and electrical-resistant alloys account for nearly 5 per cent, while electroplaters use about 2.5 per cent. The remainder is used for rolled nickel and high-nickel alloys for various products. The price of nickel in Canada and the United States remained unchanged during 1941 at figures prevailing for over fifteen years. No price changes are anticipated in the immediate future.

* * *

Aircraft Engine Production

The Pratt & Whitney Division of the United Aircraft Corporation has announced that its output of engines in November, 1941, totaling 2,000,000 H.P., was more than twice the output in November, 1940, and fifteen times as great as the output in November, 1938. The peak production of Pratt & Whitney engines will be reached within six months, and the supply of this company's air-cooled engines will be added to, in 1943, by the productive capacities of four licensees—the Ford Motor Co., the Buick and the Chevrolet Divisions of the General Motors Corporation, and the Jacobs Aircraft Engine Co.

* * *

According to an estimate of the National Association of Manufacturers, 14 W. 49th St., New York City, the American manufacturing industry spent close to $120,000,000 for research during the past year.

The Air-Conditioning of Industrial Plants

During the past year, there have been a large number of air-conditioning installations in manufacturing plants. Several windowless plants have been built, and a manufacturing plant without windows must, necessarily, have some form of air-conditioning. Among the noteworthy air-conditioning installations of the past year was the new blackout type turbo-supercharger plant erected by the General Electric Co. at Everett, Mass. In this plant, adequate ventilation and controlled temperature conditions are maintained by the air-conditioning system. One of the primary requirements in the design of the system, however, was to provide close temperature control throughout the year for the numerous very accurate machining processes on various metal alloys that are carried out in this plant.

As the building is well insulated, the amount of heat released by the heating equipment and machinery used for various processes in the manufacture of superchargers, in addition to the heat from the fluorescent lighting, is sufficient to heat the building, even when the outdoor temperature is only 15 degrees above zero. For this reason, the ventilating and air-conditioning system was concerned chiefly with cooling rather than heating.

The air-conditioning system is designed to produce a maximum of 11 degrees of cooling when the outdoor temperature is 91 degrees. This required 1140 tons of refrigeration, which is provided by eighteen 60-H.P., eight-cylinder, reciprocating condensing units with direct expansion coils. There are six fans which serve six independently controlled zones. All the major equipment is located on three mezzanines. The air is distributed to the six zones through ducts and ceiling dischargers of the venturi bowl type, which are located at the level of the bottom of the building trusses, approximately 18 feet above the floor.

Fresh air is brought in at each mezzanine in sufficient quantity to provide for four air changes an hour, except at peak cooling and heating loads. As there are no windows, provision is made for full exhaust capacity as well. All entering air is filtered by automatic air filters. When heating of the air is necessary, this is done by means of steam coils.

* * *

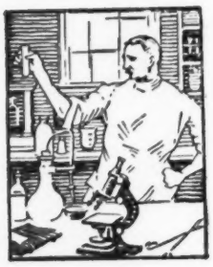
Sixty-Ton Tanks in Production at the Baldwin Plant

The first heavy 60-ton tank built in the United States, produced by the Baldwin Locomotive Works, Eddystone, Pa., was formally accepted by Brigadier General G. M. Barnes for the United States Army at ceremonies held in Eddystone on December 8. About 350 people, including some of the country's leading industrialists and officers of the Army, were present at the dedication ceremonies.

The giant tank was put through a series of demonstrations indicating how completely the "monster" was under the control of its navigator. The climax of the exhibition was a mock battle, in which were engaged, besides the 60-ton tank, two 30-ton and three light United States Army tanks. The battle scene was quite realistic. It took place over a heavily mined terrain. One tank burst into flames, and an enemy fortification was shelled and destroyed.

The First Heavy 60-ton Tank Built in the United States, Recently Completed by the Baldwin Locomotive Works, Eddystone, Pa.

MATERIALS OF INDUSTRY

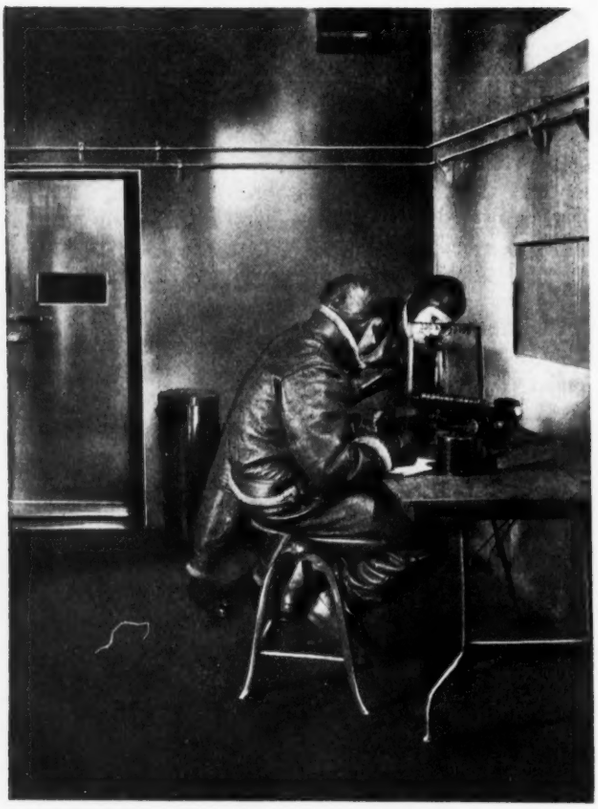


THE PROPERTIES AND NEW APPLICATIONS OF MATERIALS USED IN THE MECHANICAL INDUSTRIES

Weather Laboratory is Lined with Stainless Steel

To make sure that essential defense products will serve dependably in every American climate —from that of the Canal Zone to that of northern Alaska—the Sperry Gyroscope Co., Brooklyn, N. Y., tests its instruments and machinery parts in a unique "all-weather laboratory" which is sheathed with stainless steel, according to the *Electromet Review*. Within this laboratory are produced, under automatic control, temperatures ranging from minus 40 degrees to plus 150 degrees F.; humidities from apparatus "dew-point" to 100 per cent; rain, fresh water, and salt water fogs; and ultra-violet light to simulate intense sunshine.

It was decided to line the room with a chromium-nickel stainless steel containing molybdenum, because this material has good resistance to moisture and corrosion, to deterioration under penetrating light rays, and to mechanical damage. In constructing the laboratory, the entire lining was welded into a single seamless shell. This shell is floated within insulated walls to allow for expansion and contraction, touching the insulated structure at window and door openings only, where it has a sliding contact. The ceiling is suspended from the center, and the floor is anchored securely at a central drain. The exterior of the room is constructed of "Ludlite Bord," which is a paneling of stainless steel having a mineral composition backing. 201



In the Sperry Stainless-steel Laboratory, Lubricants for Anti-aircraft Equipment are being Tested at Minus 35 Degrees F.

Blue Filter Glass for Aluminum and Bronze Welding

"Alubro-Weld," a blue glass compounded to filter out injurious rays of light in conditions of excessive glare, is a recent development of the Willson Optical Research Laboratories, Reading, Pa. This special welding glass, which is quite different from the ordinary cobalt blue glass, is specifically recommended for aluminum and bronze welding, glass work, instrument making, and other operations where a sodium yellow glare is encountered. Although "Alubro-Weld" glass has a much higher visible light transmission than the ordinary blue glass, it blocks out the harmful ultra-violet rays entirely, and greatly reduces the transmission of injurious infra-red rays. Thus, it is claimed that welders of aluminum and bronze can see their work better through lenses made of this material. The flow of metal to the weld can also be more accurately controlled, reducing corrective grinding operations to a minimum. 202

To obtain additional information about materials described on this page, see lower part of page 162

New Regalvanizing Process for Rustproofing Welded Joints

A new patented process that enables galvanized or other sheets and structural metal parts to be welded together, regardless of size, so that the joints are left in a thoroughly rustproof condition has been announced by Gav-Weld Inc., Mutual Home Bldg., Dayton, Ohio. In the case of welded joints of galvanized material, regalvanizing is accomplished at the time of welding and no redipping is necessary.

The process consists essentially of rubbing a stick of low-melting galvanizing material over the bare spots, which have been heated by the welding. This produces a smooth coating of metal having all the corrosion- and wear-resistant qualities of the original galvanized coating. The elimination of the present practice of redipping the entire product after welding to prevent corrosion at the joints results in savings in zinc, which is especially important now.

An additional feature of the Gav-Weld process is that it permits a welded joint to be painted or enameled without danger of sweating. The necessity of applying a filler coat before finishing such a joint is eliminated. When baking is required to harden the finish, this can be done without harm to the joint.

National distribution of Gav-Weld materials to licensed users of the patented process is being provided through the Metallic Products Division of the Eagle-Picher Lead Co., Cincinnati, Ohio. This process is expected to find widespread application in shipbuilding and contracting work; the manufacture of tanks, cans, barrels, and other containers; the construction of prefabricated steel houses; and the building of railroad cars, airplanes, and trucks.....203

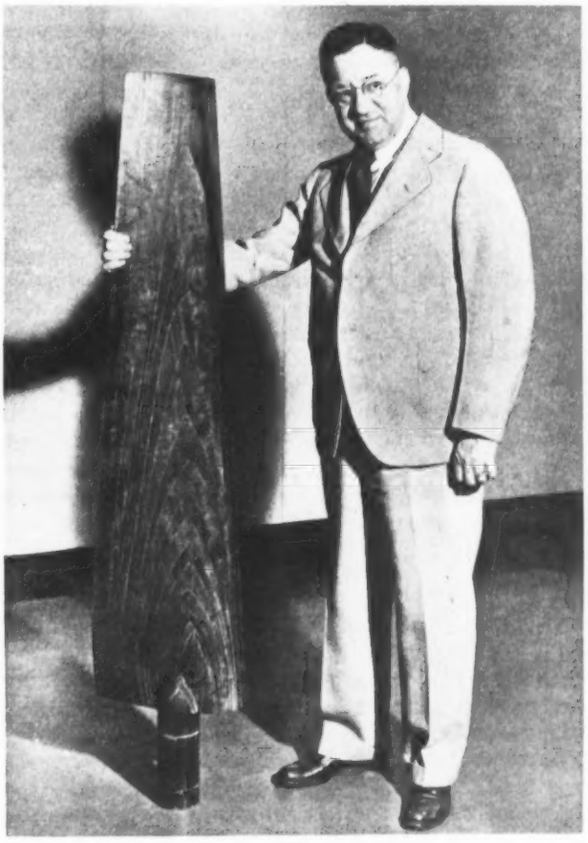
A Material Whose Electric Resistance Decreases with Rising Temperature

An electric resistant material, the resistance of which decreases with rising temperature, has been placed on the market by the Keystone Carbon Co., Inc., 1935 State St., St. Marys, Pa. Resistors made from this material are used to reduce or eliminate initial current surge in electrical equipment, to compensate for resistance changes due to temperature variations, and to provide various degrees of time delay in electrical equipment. Resistors made from this material have stable characteristics for a long period of time provided they are not excessively overloaded. They are strong mechanically, and have "molded-in" connections that provide secure and permanent electrical contact. They can be manufactured in a wide variety of sizes and shapes. 204

Long Plastic Mold for Making Fan Blades

The longest mold ever made by the plastics department of the General Electric Co. is being used at West Lynn, Mass., to produce fan blades formerly made of metals. These blades, which are 4 1/2 feet long, are made of molded laminated Textolite and weigh 25 pounds apiece.

The fans, manufactured by the Foster Wheeler Corporation, New York City, are used in large cooling towers required for cooling great quantities of water needed for power plants, condensing oil refineries, air-conditioning installations, and similar applications. For the most efficient and economic operation, a light fan blade is particularly important. The new plastic blade is lighter than the metal blade it replaces, but is of about equal strength. Corrosion was the chief trouble encountered in the use of the metal blades. This problem was particularly acute in localities where the blades of the fans came in contact with even a small amount of salt water. To offset this, the metal blades had to be painted and baked. The plastic fan eliminates this difficulty. It is also claimed that the theoretically correct shape and the smoothness of the blade increase the efficiency. 205



Textolite Fan Blade Produced by the Longest Mold ever Used by the Plastics Department of the General Electric Co.

To obtain additional information about materials described on this page, see lower part of page 162

NEW TRADE LITERATURE

Recent Publications on Machine Shop Equipment, Unit Parts and Materials. To Obtain Copies, Fill in on Form at Bottom of Page 161 the Identifying Number at End of Descriptive Paragraph, or Write Directly to Manufacturer, Mentioning Catalogue Described in the January Number of MACHINERY

Electric Equipment

GENERAL ELECTRIC CO., Schenectady, N. Y. Booklet GED-972A, descriptive of the Thy-mo-trol electronic control system for the operation of direct-current motors from alternating-current lines. Circular GEA-3660, on G-E 2300-volt starters with complete protection in one unit. Circular GEA-3685, on a new fractional-horsepower motor for machine tools. 1

Industrial Control Devices

BROWN INSTRUMENT CO., Philadelphia, Pa. Catalogue 8301, on industrial control devices for temperatures, pressures, flows, liquid levels, and humidity. Bulletin 23-57, containing technical data on Brown control systems for forging furnaces. Bulletin 92-4, containing technical data on the Brown A. C. Analy - Graph for continuously measuring and recording the quality of furnace atmosphere. 2

Air-Operated Machine Controls

A. SCHRADER'S SON, Division of Scovill Mfg. Co., 470 Vanderbilt Ave., Brooklyn, N. Y. Catalogue 10, "Industrial Products for Efficient Air Control," describing equipment for use in the control of compressed air, including a great number of new fittings and complete air-operated machine-control sets applicable to presses, spot-welders, machine clutches, etc. 3

Defense Production

BALDWIN LOCOMOTIVE WORKS, Philadelphia, Pa. Publication entitled "The Baldwin Group in Production for Defense," containing illustrations and brief descriptions of the munitions and materiel produced, including tanks, guns, shells, armor plate, airplane parts, propeller shafts and other parts used in naval vessels, etc. 4

Automatic Control Instruments

BRISTOL CO., Waterbury, Conn. Bulletin 585, containing a condensed index of this company's line of products, including automatic control instruments, recording and indicating instruments, and telemetering instruments for recording and remote automatic control. 5

Oxy-Acetylene and Electric Arc Welding Procedures

AIR REDUCTION, 60 E. 42nd St., New York City. 55-page book entitled "Welding Procedures," describing the proper welding process for various metals under different circumstances, the best filler metals for each process, and specialized welding techniques not commonly known. 6

Electrical Equipment

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. New edition of the Quick Selector catalogue containing 60 pages arranged to simplify the selection of electrical equipment for any motor, lighting, or feeder circuit. Folder F-8623, descriptive of small motors ranging from 1/6 to 1/2 H.P. for general use. 7

Attachments for Contour Sawing Machines

CONTINENTAL MACHINES, INC., 1312 S. Washington Ave., Minneapolis, Minn. Catalogue descriptive of attachments designed for use on DoAll contour sawing machines, including mitering, disk-cutting, polishing and grinding, beveling attachments, etc. 8

Deep-Hole Drilling and Boring Machines

W. F. & JOHN BARNES CO., Rockford, Ill. Circular illustrating and describing the Barnes No. 420 deep-hole drilling and boring machines especially applicable for handling gun tubes, landing gear cylinders, propeller shafts, and other long work. 9

Blueprinting Machinery

C. F. PEASE CO., 2601 W. Irving Park Road, Chicago, Ill., is distributing a calendar for 1942 entitled "Calendar of Stars," each page of which shows a picture of a motion picture star. The pages also show various models of Pease blueprinting machines. 10

Cleaning Materials

OAKITE PRODUCTS, INC., 26 Thames St., New York City. "Cleaning Methods that Speed Munitions Production," giving data on cleaning high-explosive, anti-aircraft, and howitzer shells before inspection and painting, either by mechanical washing machine or tank cleaning methods. 11

Engineering Tables for Hydraulic Engineers

WATSON-STILLMAN CO., Roselle, N. J. Bulletin 120-A, containing engineering tables of value to hydraulic engineers, including tables of capacities of hydraulic rams, discharge of water for circular straight-edge orifices, hydraulic formulas, etc. 12

Drills for Hardened Steel

BLACK DRILL CO., 5005 Euclid Ave., Cleveland, Ohio. Pamphlet containing information on the correct use of "Hardsteel" drills, which can be used for drilling, countersinking, and reaming hardened steel. The data includes speeds, feeds, coolants, etc. 13

Precision-Ground Bench Plates

CHALLENGE MACHINERY CO., Grand Haven, Mich. Circular list-

ing the nine standard sizes of precision-ground, semi-steel bench plates made by this concern, which are particularly applicable for the inspection and assembly of small parts in aviation and automotive plants. 14

Meehanite Castings

MEEHANITE RESEARCH INSTITUTE OF AMERICA, INC., 311 Ross St., Pittsburgh, Pa. Bulletin entitled "Meehanite Castings in Defense Work," describing the use of these castings in aircraft manufacture, gun and shell manufacture, machine tools, and radio, marine, truck, and steel mill equipment. 15

High-Speed Sanders

SUNDSTRAND MACHINE TOOL CO., 2530 Eleventh St., Rockford, Ill. Bulletin RM-1, entitled "Finishing Suggestions," containing illustrations showing the use of the new Sundstrand "Hi-Speed" sander on various classes of work. 16

Saw-Sharpening Machines and Tools

WARDWELL MFG. CO., Cleveland, Ohio. Catalogue 40, illustrating and describing machines for automatically sharpening various kinds of saws used for cutting wood or metal. 17

Patent Information

ALLIS-CHALMERS MFG. CO., Milwaukee, Wis. Booklet entitled "Patent Background for Engineers," containing fifty-four pages of information on patents and patent procedure, designed primarily for engineers and executives who deal with inventions. 18

Aluminum-Bronze Welding Rod

AMPCO METAL, INC., 1745 S. 38th St., Milwaukee, Wis. Catalogue describing in detail the welding technique and application of "Ampco-Trode" coated aluminum-bronze welding rod, suitable for arc welding and oxy-acetylene welding. 19

Self-Lubricating Bearings

JOHNSON BRONZE CO., 520 S. Mill St., New Castle, Pa. Catalogue L-3, listing 2000 standard sizes of Ledaloyl self-lubricating bronze bushings and bearings, intended to serve as a guide for designing engineers. 20

Cutting Fluids

STANDARD OIL CO. OF NEW JERSEY, 26 Broadway, New York City. Booklet entitled "Cutting Fluids," describing the Esso Marketers cutting fluids, selection of these materials, suggestions on handling them, etc. 21

Standard Steel Shapes

COMMERCIAL SHEARING & STAMPING CO., Youngstown, Ohio. Booklet listing standard steel shapes available without die or tool charges. Drawings and complete data on the various shapes are included. 22

Cleaning Machines and Solutions

L & R MFG. CO., 54 Clinton St., Newark, N. J. Pamphlet on the industrial cleaning machines and solutions made by this concern; also describes method of using them in the instrument overhaul shop of American Airlines. 23

Near Infra-Red Process for Baking, Preheating, etc.

FOSTORIA PRESSED STEEL CORPORATION, Fostoria, Ohio. Catalogue entitled "The Near Infra-Red Process," describing the use of this process in baking ovens, preheating operations, drying, etc. 24

Motorized Drive for Machine Tools

REEVES PULLEY CO., Columbus, Ind. Circular G-421, descriptive of the new Reeves machine tool drive equipped with "Motodrive" unit or "Vari-Speed" motor pulley for infinite variable-speed control. 25

Shell Centering Machines

STOKERUNIT CORPORATION, 4548 W. Mitchell St., Milwaukee, Wis. Leaflet illustrating and describing Simplex machines for centering high-explosive shells automatically on the conveyor line. 26

To Obtain Copies of New Trade Literature

listed on pages 160-162 (without charge or obligation), fill in below the publications wanted, using the identifying number at the end of each descriptive paragraph; detach and mail to:

MACHINERY, 148 Lafayette St., New York, N. Y.

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.

Name ..... *Position or Title* .....

[This service is for those in charge of shop and engineering work in manufacturing plants.]

Firm .....

Business Address .....

City ..... *State* .....

[SEE OTHER SIDE]

Electric Markers and Etchers

H. P. PREIS ENGRAVING MACHINE CO., 155 Summit St., Newark, N. J. Circular L41-2, descriptive of the Panto Utility engraver, electrical marker, and acid etcher with interchangeable unit heads. 27

Whiteprint Machines

OZALID PRODUCTS DIVISION OF GENERAL ANILINE & FILM CORPORATION, Johnson City, N. Y. Bulletin illustrating and describing the new Ozalid Model B fast-printing whiteprint machine. 28

Precision Measuring Tools

VAN KEUREN CO., 176 Waltham St., Watertown, Mass. Catalogue containing 68 pages of information on precision measuring tools, including light waves, gage-blocks and measuring wires. 29

Precision Slotters

DOUGLAS MACHINERY CO., INC., 150 Broadway, New York City. Circular descriptive of the Douglas precision slotter, which is available in three sizes, with 7 1/2-, 8 1/2- and 10-inch stroke. 30

Bearing Metals

NATIONAL BEARING METALS CORPORATION, St. Louis, Mo. Circular listing the bearing metals made by this concern for use in the war industries, as well as on regular industrial work. 31

Plastic Sheets

PLASTICS DIVISION, CARBIDE AND CARBON CHEMICALS CORPORATION, 30 E. 42nd St., New York City. Booklet containing complete data on the Vinylite plastic sheet forms produced by this company. 32

Self-Lubricating Bearings

BOUND BROOK OIL-LESS BEARING CO., Bound Brook, N. J. Circular showing over 150 different sizes and shapes of "Compo" oil-retaining porous bronze bearings produced by powder metallurgy. 33

Temperature Control Instruments for Plating

FOXBORO CO., Foxboro, Mass. Bulletin B-296, descriptive of temperature control instruments for plating and other metal-finishing operations. 34

Chains and Sprockets

WHITNEY CHAIN & MFG. CO., Hartford, Conn. Catalogue V-140, containing engineering data and specifications covering the Whitney line of conveyor chains and sprockets. 35

Demagnetizers

IDEAL COMMUTATOR DRESSER CO., Sycamore, Ill. Circular describing the Ideal demagnetizer for demagnetizing tools, drills, punches, dies, and work that is held on magnetic chucks. 36

Wrenches

BLACKHAWK MFG. CO., Milwaukee, Wis. Handy wrench guide, describing socket, box type, specialty, and torque indicating wrenches, and their uses. 37

Welding Alloys

EUTECTIC WELDING ALLOYS, INC., 40 Worth St., New York City. Technical data book on low-temperature welding with Castolin eutectic alloys and fluxes. 38

Oil-Fired Heaters for Furnaces and Ovens

DESPATCH OVEN CO., Minneapolis, Minn. Bulletin 73, descriptive of Despatch direct oil-fired heaters applicable to ovens, dryers, and furnaces. 39

Electric Equipment

DEAN W. DAVIS & CO., INC., 549 Fulton St., Chicago, Ill. Catalogue 10, on Davis solenoids, coils, and transformers. 40

Gage-Blocks and Optical Flats

GEORGE SCHERR CO., INC., 128 Lafayette St., New York City. 8-page folder on the uses of gage-blocks and optical flats. 41

Soldering

WAYNE CHEMICAL PRODUCTS CO., 9470 Copeland St., Detroit, Mich. Folder entitled "A New Soldering Process." 42

To Obtain Additional Information on Shop Equipment

Which of the new or improved equipment described on pages 163-176 is likely to prove advantageous in your shop? To obtain additional information or catalogues about such equipment, fill in below the identifying number found at the end of each description—or write directly to the manufacturer, mentioning machine as described in January, 1942, MACHINERY.

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.

Fill in your name and address on other side of this blank.

To Obtain Additional Information on Materials of Industry

To obtain additional information about any of the materials described on pages 158-159, fill in below the identifying number found at the end of each description — or write directly to the manufacturer, mentioning name of material as described in January, 1942, MACHINERY.

No.	No.	No.	No.	No.	No.	No.	No.	No.

Fill in your name and address on other side of this blank.

Detach and mail to MACHINERY, 148 Lafayette St., New York, N. Y.

[SEE OTHER SIDE]

Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on the Market

Gleason Hypoid Gear-Tooth Grinder

The teeth of generated curved-tooth bevel and hypoid gears and pinions can be finished by precision grinding on the new No. 17 hypoid grinder brought out by the Gleason Works, Rochester, N. Y., at a production rate many times faster than has previously been possible by the cutting method. Advantages claimed for bevel gears finished on this new grinder include correction of distortion caused by heat-treatment, all teeth made uniform, surface irregularities eliminated, tool marks removed, and tooth profile and fillet blended smoothly into the bottom land. These refinements all result in smoother, quieter gears.

The generating motion employed on this grinder is entirely different from any formerly used, combining continuous rotation of the work-spindle with a reciprocating motion of the wheel-carrying cradle. This has been worked out in such a way as to give grinding speeds never before obtainable in a generating grinder.

The dressers for the grinding wheel are hydraulically operated. After operating the control lever, the dressing is entirely automatic, including advance of the wheel, and side, end, and radius dressing. The dressers are completely adjustable for feed, pressure angle, radius, and wheel diameter.

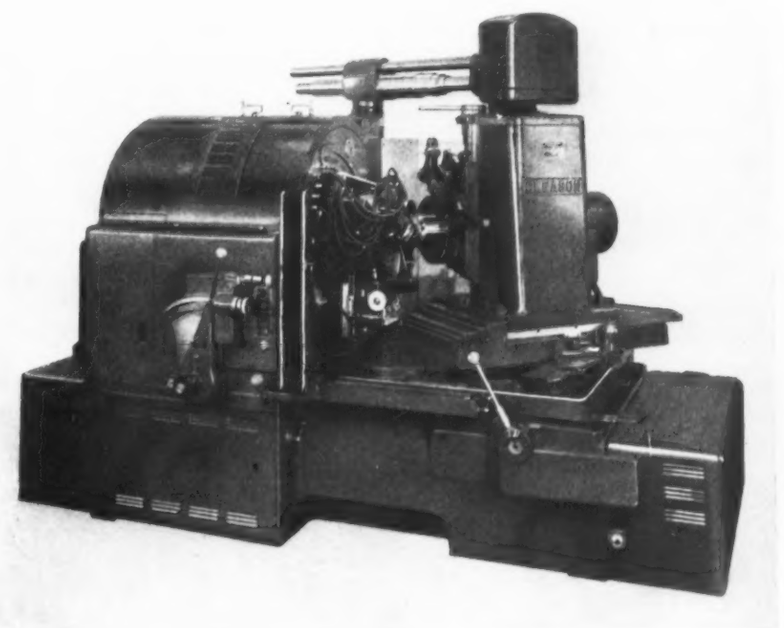
In grinding a gear, the wheel is alternately fed to the work during the up roll of the cradle and withdrawn during the down roll of the cradle. The work, in the meantime, rotates continuously, so that the wheel, when starting on the next up roll, engages the following tooth. This cycle is repeated until all the teeth are ground, at which time the machine stops automatically. Hydraulic movement of the sliding base to and from the cutting position and a new type of hydraulic chuck provide speed and ease in changing the work.

Control of tooth bearing is obtained by dressing the wheel to a modified shape and by modifying the generating roll. Change-gears control indexing from tooth to tooth and wheel speed, while cams control the generating roll and the feed. The cup type of grinding wheel is comparable to the face-mill type cutter employed on Gleason hypoid generators.

The machine has a maximum cone distance capacity of 12 1/2 inches, and handles gears up to 2 1/2 diametral pitch. The maximum whole-depth capacity is 3/4 inch; maximum face width, 2 1/2 inches; ratios, from 1 to 1 to 4 1/2 to 1 with shafts at 90 degrees; wheel diameters, 5 3/4 to 13 1/2 inches; and feeds, 1.9 to 11.8 seconds per pass per tooth. The machine requires a floor space of 65 3/4 by 111 3/4 inches. 51

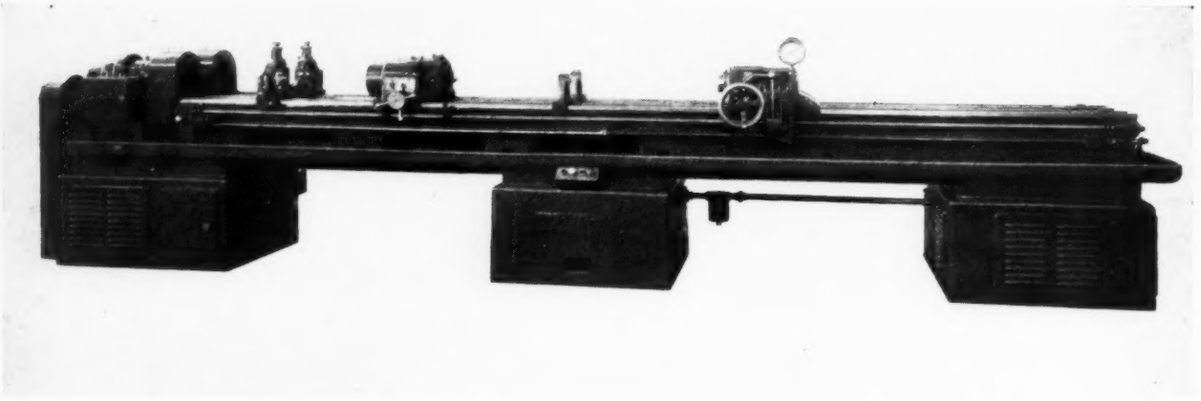
Airgrip Shell-Holding Equipment

A line of shell-holding equipment consisting of collet chucks and expanding arbors has been developed by the Airgrip Chuck Division of the Anker-Holth Mfg. Co., Port Huron, Mich. This equipment is suitable for holding shells from 20 to 155 millimeters in diameter. It includes arbors with and without adjustable stops, and collets for trench mortar shells. For operating these devices, the company's Model D double-acting air cylinder is recommended. 52



Gleason Gear-tooth Grinder for Finishing Generated Curved-tooth Bevel and Hypoid Gears

To obtain additional information on equipment described on this page, see lower part of page 162



Double-spindle Gun-barrel Drilling and Reaming Machine Made by Builders Iron Foundry

Gun-Barrel Drilling and Reaming Machine

A double-spindle gun-barrel drilling and reaming machine arranged for deep-hole drilling from the solid has been developed by the Builders Iron Foundry, 9 Codding St., Providence, R. I. This No. 1A machine can also be used for either draw or push type reaming and boring, the range of speeds and feeds being wide enough for deep-hole drilling, reaming, and boring operations. Each of the two spindles is driven from a 3-H.P., 900-R.P.M. motor, located in the base below the headstock of the machine and transmitting power through a V-belt and gears to the roller-bearing headstock, which carries a four-jaw independent chuck for holding the barrel.

The barrel, secured in the four-jaw chuck, is supported in steady-rests, adjustable along the ways of the machine, and in the barrel support and drill guide member shown at the center of the machine. The D type deep-hole drill is fastened in a chuck in the machine carriage, provided with a tool-bar support adjustable along the ways, and guided by a bushing in the work-support member to insure concentricity of the bore with the outside of the barrel.

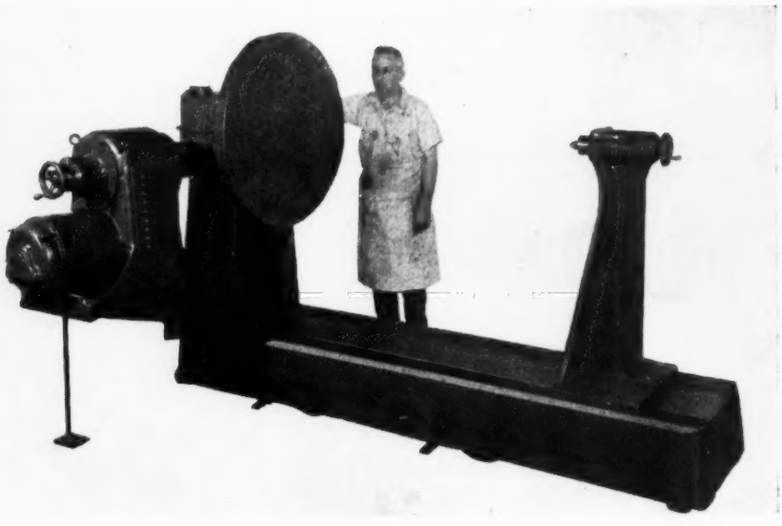
A torque overload protective device on the carriage can be set to trip when any predetermined torque on the drill is reached, thus protecting the drill against breakage when hard spots or other drilling difficulties are encountered. The torque release operates a limit switch, which stops the motor and simultaneously releases a clutch to disengage the lead-screw and prevent further movement of the carriage.

Oil from a reservoir in the center leg of the machine is pumped through a magnetic type filter designed to remove small metal particles. This oil is pumped through piping into the carriage of the machine and then through the drill shank to the cutting edge of the drill. Each of the two pumps located in the leg of the machine at the carriage end is driven by a 5-H.P., 1800-R.P.M., direct-connected motor. The pump capacity is 10 gallons per minute operating at a pressure of 700 pounds per square inch.

The machine has six spindle speeds ranging from 175 to 1090 R.P.M. There are two feed ranges, one for drilling and one for milling. The drilling range includes eleven feeds, from 0.0005 to 0.003 inch per revolution. The machine has a capacity for boring holes from 0.5 inch to 1.5 inches in diameter and up to 84 inches long. The stroke is 144 inches, and the swing 10 1/2 inches. 53

Globe Heavy-Duty Winding Machine

The new heavy-duty coil-winding machine of the CW-72 size developed by the Globe Tool & Engineering Co., 438 Davis Ave., Dayton, Ohio, can be furnished with or without the bed and tailstock. When the bed and tailstock are not required, the winding head unit can be mounted on a suitable pedestal to increase the swing of the machine, which is normally 72 inches. A U. S. Motors Varidrive,



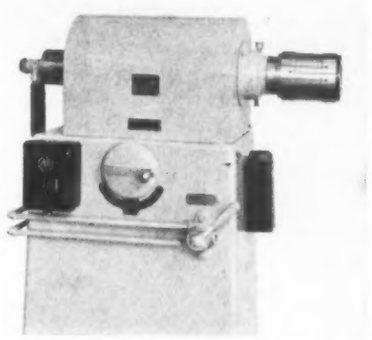
Heavy-duty Coil-winding Machine Placed on the Market by the Globe Tool & Engineering Co.

To obtain additional information on equipment described on this page, see lower part of page 162

direct-connected to the head by a flexible coupling, drives the machine spindle through a large hardened and ground worm-gear, which runs in a bath of oil.

Direct-drive and back-gears, similar to those used in standard lathe-head construction, provide a stepless change of speeds ranging from 2 to 120 R.P.M. Higher speed ranges can be obtained by changing the gear ratio in the variable-speed drive. These machines are regularly equipped with a 220- to 440-volt, three-phase, 60-cycle motor of the alternating current type; but motors of other voltages and cycle specifications can be furnished. A 5-H.P. motor is used on the machine shown, but motors of from 2 to 10 H.P. are available, depending on the torque requirements of the winding spindle.

Control of the winding operation is through a foot-treadle, which is accessible along the full length of the bed. An interlocking arrangement permits reversing the spindle. The worm-gear drive prevents uncoiling when the winding is subjected to unusually heavy tension. 54



Schauer Speed Lathe Equipped with Air-operated Mandrel

Simplex Shell-Centering Machine

A shell-centering machine designed to fit directly into the conveyor line and thus eliminate the necessity for lifting the heavy shell forgings is a recent product of the Stokerunit Corporation, 4548 W. Mitchell St., Milwaukee, Wis. This machine, known as the Simplex, has been developed specifically for centering high-explosive shell bodies in preparation for succeeding machining operations, and can be furnished to handle 90-, 105-, or 155-millimeter shells.

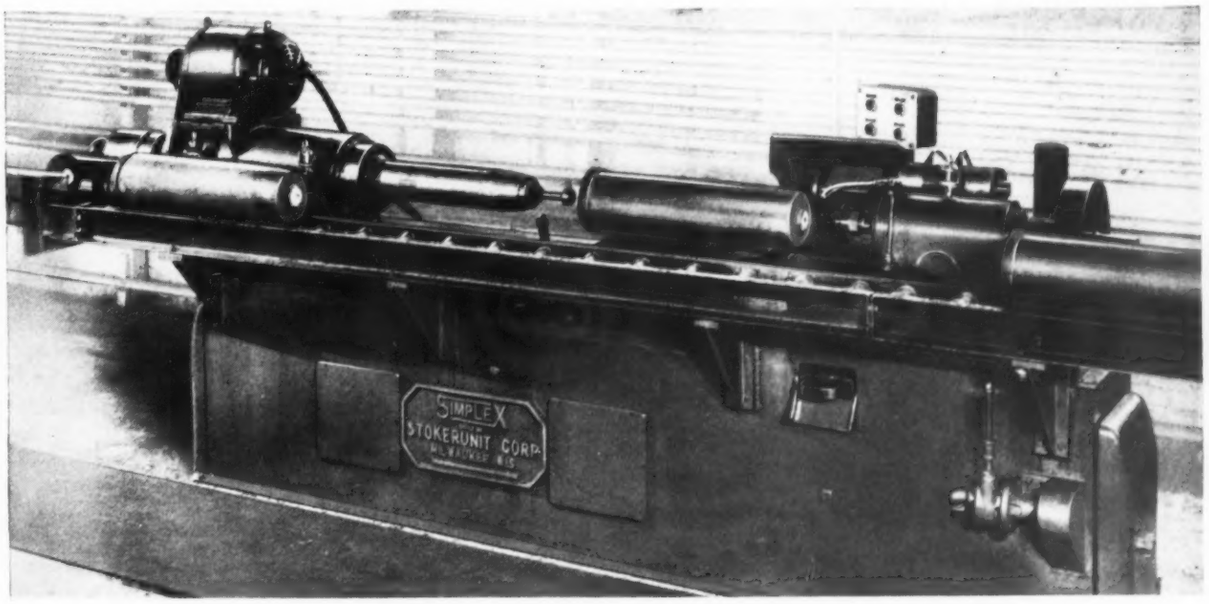
It is fully automatic in operation, and can be easily handled by unskilled help after a very brief instruction period. The operator simply rolls the shell from the conveyor to the work tray and pushes the button that starts the automatic cycle. A half minute later the centered shell is rolled back on the conveyor. Production is 100 shells an hour at an operating efficiency of 85 per cent.

The electric-hydraulic, fully automatic cycle completely controls the shell after the starting button is pressed. This cycle advances the table, forcing the mandrel fully into the shell against a spring-loaded stop, expands the mandrel to hold the shell firmly, drops the work tray, and starts the mandrel and the centering tool revolving in opposite directions. The centering tool advances, drills the center, and retracts. The mandrel then releases the shell, the table returns, and the work tray comes up to receive the centered shell. 55

Schauer Speed Lathe Equipped for Polishing Aircraft-Engine Barrels

A new type of variable-speed lathe designed especially for polishing and finishing engine barrels for aircraft engines, which is equipped with an expanding mandrel for holding the work, has been brought out by the Schauer Machine Co., 2060 Reading Road, Cincinnati, Ohio. The mandrel is air-operated and is controlled by means of a hand air-valve which can be replaced by a foot control if desired. An automatic brake is applied when the foot-treadle is depressed to stop the motor.

Any spindle speed from 105 R.P.M. to 1155 R.P.M. can be obtained while the machine is running. The machine is regularly



Simplex Shell-centering Machine Developed by the Stokerunit Corporation

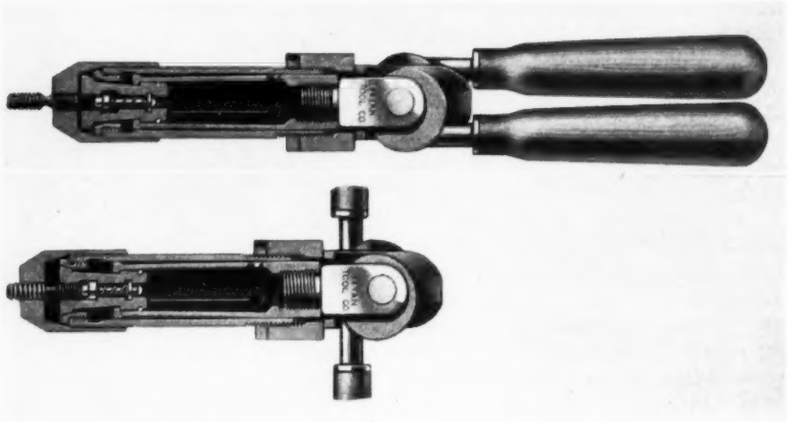
To obtain additional information on equipment described on this page, see lower part of page 162

equipped with a two-speed 1/2-H.P., 875 to 1750 R.P.M. motor. It can be furnished with either a single or a two-speed motor, providing spindle speeds of between 25 and 4000 R.P.M. in a ratio of 5 1/2 to 1 with a single-speed motor and 11 to 1 with a two-speed motor. Either a three- or four-jaw chuck or a special holding device can also be supplied. 56

Walker-Turner Drilling Machines

A 20-inch drilling machine of improved design, available for either power-, hand-, or foot-feed applications, is being manufactured by the Walker-Turner Co., Plainfield, N. J. Rugged construction has been incorporated in the design of this machine to adapt it for production work. One of the outstanding features is the power feed unit. The built-in clutch, which is part of the worm drive, is designed to give a smooth, positive action at all points of the spindle travel. The feed unit is driven from the machine spindle, four rates of feed being provided for each of the five spindle speeds.

Walker-Turner Drilling Machine Designed for Production Work



Stud-setting Tool with Quick-loading Feature, Made by the Titan Tool Co.

An easily read chart indicates the rate of feed in thousandths of an inch per revolution of the spindle. The feed range is suitable for all drilling and reaming operations from 1/16 up to 1 inch in cast iron. The machine is equipped with a No. 2 Morse taper spindle nose, and is available in single- or four-spindle models. 57

Magnetic Oscilloscope for Resistance Welding

A peak-reading portable instrument, known as the magnetic oscilloscope, has been developed by the General Electric Co., Schenectady, N. Y. While designed primarily for use in resistance welding, it may be applied as a supplement to other instruments used in making installation adjustments.

Among the varied uses of the oscilloscope in the field of resistance welding are checking operation of electronic controls; adjustment of starting angle of control to correspond with power-factor angle of welding machines; adjustment of full-wave setting on control of phase-controlled welding machines to correspond with the 100 per cent "heat" of the control dial; current measurement (full wave only) for very brief "on" intervals; voltage regulation measurements; observation and measurement of magnitude of starting transients on non-synchronous welding controls; and pointer-stop current measurements.

The instrument weighs about 14 pounds; it is 7 inches high, 6 inches wide, and 17 inches long. 58

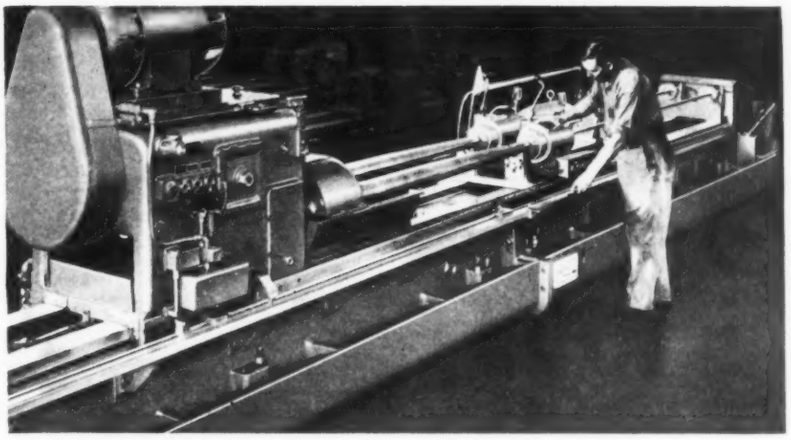
Stud-Setter for Use in Aircraft Work

A manually driven tool, known as the "Titan Victory" stud-setter, designed especially to meet the requirements of stud-driving in the aeronautical industry, has been brought out by the Titan Tool Co., Fairview, Pa. With this tool, loading and releasing of the stud are accomplished almost instantly. The device eliminates the necessity for screwing the studs on and off the driver. Alignment of the threads on the clamping jaws of the tool with those on the studs is accomplished by a sliding movement or thrust of the stud-driver.

The upper view in the accompanying illustration shows the tool with jaws open ready for loading, while the lower view shows the driving jaws closed and clamped tightly around the nut end of the stud. In this case, the handles are in the driving position. Clamping of the driver to the stud prevents mutilation of the threads or bulged ends. The plating on the studs is not disturbed in any way by this tool.

The clamping is effected by cams acting on a draw-bar. The cams are part of the handle assembly. Reversing the position of the handles provides for freeing the stud from the tool. When increased driving grip on the studs is desired, the cam head can be backed off slightly from the main ring, which will accomplish the desired adjustment. To change the jaws, the cam head is moved forward to a point where the draw-tube head can open into a recess. 59

To obtain additional information on equipment described on this page, see lower part of page 162



Two-spindle Deep-hole Drilling and Boring Machine Brought out by W. F. & John Barnes Co.

Two-Spindle Drilling and Boring Machine

A two-spindle deep-hole drilling and boring machine especially intended for such parts as gun tubes, landing-gear cylinders, recoil cylinders, propeller shafts, hollow spindles, hydraulic cylinders, crankshafts, camshafts, drive-shafts, printing press rolls, axles, connecting-rods, and the like has been brought out by the W. F. & John Barnes Co., Rockford, Ill. The machine has a capacity for drilling from the solid up to 3 inches in diameter; for deep-hole boring up to 3 1/2 inches in diameter; and for cylinder boring up to 8 inches in diameter.

In this machine, the tailstock and headstock are connected by adjustable tie-bars on both sides. The saddle has a bearing surface 4 feet longer than the length of the workpiece. The tool-holder is mounted permanently on one end of the machine base. Both spindles are rotated and fed simultaneously. The self-contained hydraulic head weighs approximately 4000 pounds and is actuated by a large-diameter cylinder. This massive construction permits of smooth drilling at heavy feeds. The spindles and the hydraulic pumps are driven by the same motor, insuring a constant feed per revolution, regardless of fluctuations in the motor speed due to variations in the load. Spindle speeds from 62 to 814 R.P.M. or from 25 to 329 R.P.M. are provided.

Two coolant arrangements are available for drilling. One is by means of a duplex pump used for the single-lipped deep-hole drilling of small holes. This pump is capable of delivering 10 gallons per minute at a maximum pressure of 750 pounds per square inch. The pump used for drilling with hollow drills and for general-purpose boring is capable of delivering 40 gallons per minute at 300 pounds per square inch pressure. A third coolant pump, for cylinder boring only, is capable of delivering 50 gallons per minute at a maximum pressure of 100 pounds per square inch.

The machine is made in four sizes with strokes varying from 4 to 12 feet. The smallest machine weighs 17,000 pounds and the largest weighs 29,000 pounds. 60

Drills and Reamers that Cut Hardened Steel

A type of drill that will cut hardened steel has been developed by the Black Drill Co., 5005 Euclid Ave., Cleveland, Ohio. This tool, known as the "Hardsteel" drill, has been used successfully for drilling carburized, oil-hardened, water-hardened, cyanided, and nitrided high-carbon and high-speed steel. Tools for drilling, reaming, countersinking, and counterboring hardened steel are available.

One of the uses of these tools is for salvaging purposes, as holes can be drilled in dies, tools, and pieces of machinery which have been hardened and which cannot conveniently be annealed for machining. They are also being used as production tools for such operations as reaming chilled castings and cutting manganese steel and certain hard non-metallic materials. In spite of their hardness, they can be ground on an ordinary grinding wheel.

The reamers will ream metal of any hardness, including nitrided surfaces. It is stated that these reamers will work in hardened steel without showing unusual wear. They will also ream manganese steel and cored holes in chilled castings. 61

Taylor Drilling Machines

The Taylor Mfg. Co., 3056 W. Meinecke Ave., Milwaukee, Wis., has recently placed on the market a Model F-400 "Hi-Duty" drilling machine designed to meet the requirements for economical production drilling work. This new unit is available in either bench or floor type models and with or without electric motor.

The ball-bearing spindle is equipped with a Jacobs chuck having a maximum capacity of 1/2 inch. Drilling can be done to the center of a 16-inch circle with drills ranging in size from 1/32 to 1/2 inch. The spindle is 3/4 inch in diameter, and has a travel of 4 3/8 inches. The V-belt drive provides four spindle speeds of

"Hi-Duty" Bench Type Drilling Machine

To obtain additional information on equipment described on this page, see lower part of page 162

680, 1375, 2150, and 3450 R.P.M. A 1/3-H.P. motor is used with this machine.

The adjustable head has a 24-inch travel on the column, which is 2 3/4 inches in diameter. The work-table is 10 by 11 inches, and the base 18 by 11 1/2 inches. The over-all height of the bench type machine is 42 1/2 inches, and the weight 219 pounds. 62

Preis Improved Engraving and Marking Machine

The pantographic engraving and etching machine made by the H. P. Preis Engraving Machine Co., 157 Summit St., Newark, N. J., is now being offered to the trade in an improved design having numerous advantages over the preceding model described and illustrated in January, 1940, MACHINERY, page 189.

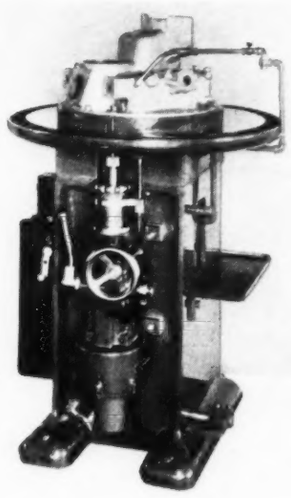
In addition to the interchangeable heads for rotary engraving and electrical marking, the machine is now furnished with a third interchangeable head for use in acid etching. The acid-etching head is used for cutting through an acid-resisting coating on metal or glass, in preparation for the application of the acid-etching fluid. This method is widely used in marking gages, tools, and machine parts, as well as such glass objects as tubes, laboratory equipment, and optical lenses.

Another improvement incorporated in the machine is the copy-holder, which consists of three or more individual slides. These slides can be positioned independently of each other to vary the space between the lines. This feature makes it possible to do, in a single set-up, many jobs that formerly required two or more set-ups. The improved machine is of the bench type, and is a compact unit 21 inches long, 14 inches wide, 15 inches high.....63

Taft-Peirce Back Spot-Facing Machine

The Taft-Peirce Mfg. Co., Woonsocket, R. I., has just brought out a machine designed for counterboring or facing bosses through which a hole has been drilled but which, because of an obstruction, cannot be counterbored on a drilling machine. The part to be machined is mounted on a substantial cast-iron table. A hole near the front of the table allows the shank of an inverted counterbore to project up through the table and the hole to be back-faced on the work boss. The cutter is driven by a spindle under the table, the driving mechanism being of ball-bearing construction and driven through bevel gears by a 1/2-H.P. motor inside the base. Interchangeable pulleys provide speeds of 170 R.P.M. for steel and 300 R.P.M. for aluminum alloys.

The spindle feed is by hand, either through a worm and worm-wheel or direct by a rack and pinion. The spindle is counterbalanced, and can be disengaged from the drive by a clutch to permit rotating the spindle freely by hand. The clutch is operated by a foot-treadle at the right-hand side of the machine, and is in engagement only when the foot-treadle is held down.

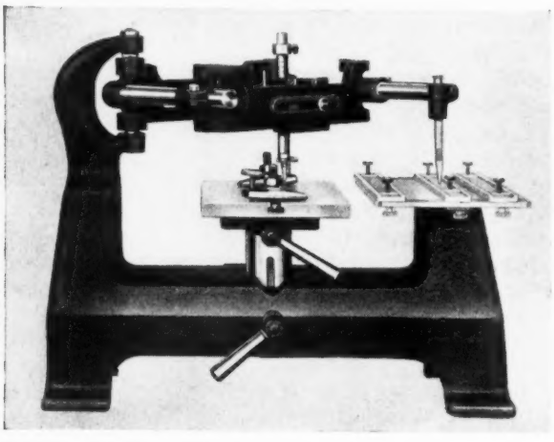


Back-facing Machine Built by Taft-Peirce Mfg. Co.

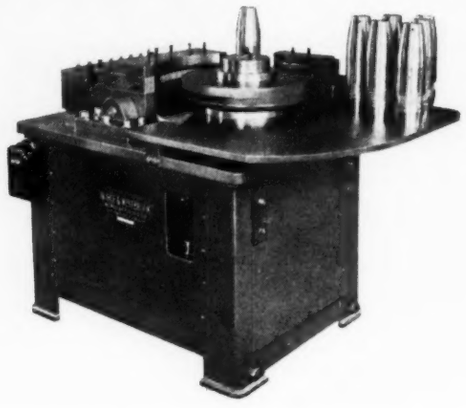
The machine is equipped with a coolant tank and pump. The maximum table diameter is 31 1/2 inches, and the working surface 28 inches in diameter. The height, from floor to table top, is 37 inches. The machine requires a floor space of approximately 34 by 32 inches. The weight is 1200 pounds. 64

Noble & Westbrook Shell Knurling and Marking Machine

A power-operated rapid-production combination machine of the dial type for knurling or scoring the band seat, and, in the same op-



Preis Bench Type Pantographic Machine with Head Used for Acid-etching Operations



Noble & Westbrook Knurling and Marking Machine for High-explosive Shells

To obtain additional information on equipment described on this page, see lower part of page 162

eration, marking the required inscription on the periphery of 75-, 90-, and 105-millimeter high-explosive shells has been brought out by the Noble & Westbrook Mfg. Co., East Hartford, Conn.

The scoring consists of producing a series of straight-line grooves in the band seat, and the marking consists of the shell designation, lot number, date, etc. Provision is made in the construction of the machine for variations in the diameter of shells within the allowable tolerances. The production rate is approximately 10 to 15 shells per minute, the rate depending upon the method of handling and the facilities provided by the user of the machine. 65

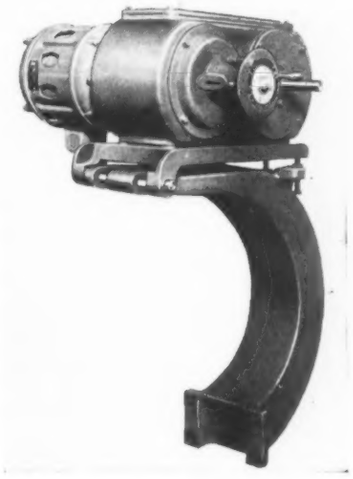
Morey New Series Shell Lathe and Thread Milling Machine

The Morey Machinery Co., Inc., 410 Broome St., New York City, has brought out the new series shell lathe shown in Fig. 1, which is similar in operation to this company's semi-automatic shell-turning lathe described in April, 1941, MACHINERY, page 193. The new machine, like the one previously described, is equipped with a shell-handling tailstock having an automatic crosswise movement that carries the shell forging into alignment with the work-holding arbor. From this position the forging to be machined can be easily pushed on the arbor by a sliding endwise movement.

The rear tool-holders of the new machine, unlike those of the original model, comprise complete, entirely separate units that include their feeding mechanism. These tool-holders can be attached after the lathe is built, and can be adjusted longitudinally to suit the work. Separate feeding adjustment for the rear tools and means for rigid holding of cutting-off or forming tools to prevent vibration are advantages of the improved design.

Among the other improvements incorporated in the new shell lathe are a bedplate similar to a floor plate, which not only acts as a substantial foundation for the bed, headstock, tailstock support, and hydraulic pumps, but also serves as a reservoir both for the hydraulic equipment oil and for the cutting lubricant; and a mechanical shift, in addition to the pick-off gears, which makes it possible to change the machine over immediately from speeds used for Carboloy tools to those suitable for high-speed tools, or vice versa. The machine weighs approximately 16,000 pounds, or nearly 2000 pounds more than the preceding model.

The thread milling machine shown in Fig. 2 is another recent development of this company. It is a horizontal type machine designed for internal or external thread milling. This machine is regularly made with a 12-inch swing, and in bed lengths of 30, 60, and 90 inches. 66



Reeves Motorized Variable-speed Machine Tool Drive

Reeves Variable-Speed Machine Tool Drive

The Reeves Pulley Co., Columbus, Ind., has brought out a motorized variable-speed drive which enables a Reeves variable-speed control unit to be applied to machine tools without the necessity of building a special support or bracket. This drive utilizes either the Vari-Speed Motodrive, as shown in the accompanying illustration, or the countershaft type Vari-Speed motor pulley. It comprises a symmetrical, compact assembly of constant-speed driving motor, variable-speed unit, and mounting bracket, which can be easily attached to most machine tools by means of four cap-screws.

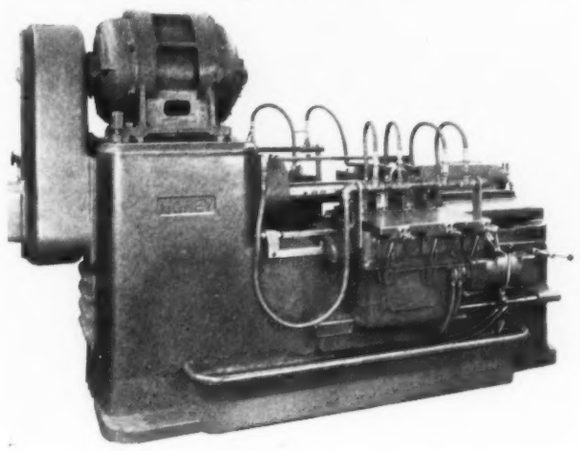


Fig. 1. Morey New Series Semi-automatic Shell-turning Lathe

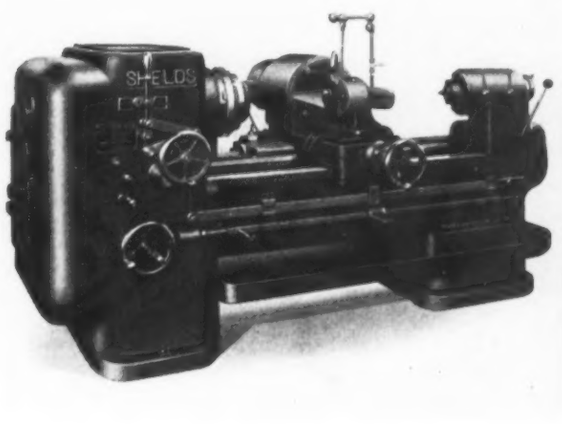


Fig. 2. Morey Horizontal Type Thread Milling Machine

To obtain additional information on equipment described on this page, see lower part of page 162

Niagara Series No. 6 Squaring Shears

Smooth, quiet, vibrationless transmission of power at any speed within the limits of the particular unit can be quickly obtained by turning a handwheel without stopping the driven machine. The motor and variable-speed unit are mounted on a pivoting base at the top of a cast semi-steel bracket. Jack-screws provide for maintaining proper belt tension between the driving unit and the driven pulley of the machine.

Two sizes of brackets are available. With the Motodrive, the capacities range from 1/4 to 10 H.P., depending on the size of unit used, and the speed ratios available are from 2 to 1 through 6 to 1. A single reduction gear speed reducer is available, if required.

With the Vari-Speed motor pulley, the capacities range from 3/4 to 7 1/2 H.P., and cover speed ratios of either 2 3/4 to 1 or 3 to 1. Both the Motodrive and the Vari-Speed motor pulley are available for either constant-torque or constant-horsepower applications. 67

Niagara Power Squaring Shears

A new line of power squaring shears, known as Series No. 6, with capacities for cutting sheets ranging from 12 gage to 3/16 inch in thickness and from 4 to 12 feet in length is being added to the metal-cutting equipment made by the Niagara Machine & Tool Works, 637-697 Northland Ave., Buffalo, N. Y.

This new line of shears is designed for precision cutting, both as regards straightness and parallelism. The shears are equipped with a ball-bearing, self-measuring, parallel back-gage with provision for making settings to 1/128 inch. The operating speed is 65 strokes per minute for flat straight shearing of narrow strips.

The drive—including flywheel, gearing, clutch, eccentrics, and connections—is enclosed and operates in oil. A direct-connected motor with starting switch is supplied as standard equipment. 68

Globe Dynamic Balancing Machines

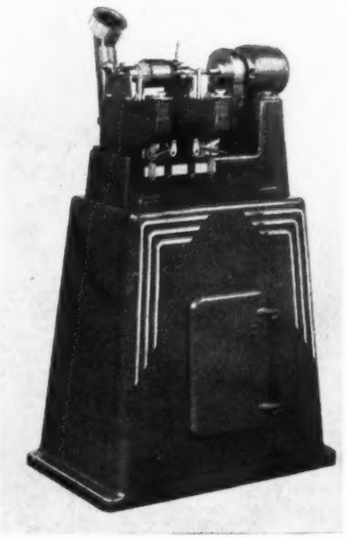
Three new dynamic balancing machines have recently been added to the line built by the Globe Tool & Engineering Co., 438 Davis Ave., Dayton, Ohio. This line now includes balancing machines covering a range of capacities adapted for determining the dynamic unbalance in rotating parts weighing from 3/4 pound up to 25,000 pounds.

Two new special super-sensitive dynamic balancing machines, like the one illustrated, are now in operation in the production line of a well-known automobile manufacturer. These special machines are designed to analyze static and dynamic balance in automobile generator armatures. By making a simple adjustment, either static or dynamic unbalance can be determined. The upper dial on the machine indicates and records the angle of unbalance in each end of the armature. Smaller dials on each supporting head show the amount of unbalance either in ounce-inches or in fractions of an ounce. These readings are determined at the time the angle of unbalance is recorded.

The Neon-Lite system used on this machine for indicating and recording the angle of unbalance is claimed to be one of the most accurate and rapid methods devised for determining unbalance in high-speed rotating parts. The cold-light properties of this system, having no lag, give the balancing machine the stroboscopic advantages of high-speed operation for accurate angle location.

The new NE-48 dynamic balancing machine is designed to determine the amount and location of the correction weights required in overcoming the dynamic unbalance in rotating parts weighing from 50 to 1500 pounds. The amount of correction required for each plane is recorded on the Micro-Indicator dials, which are sensitive to 0.2 ounce-inch of unbalance. The angle of location of the required correction for each correction plane is recorded by the Neon-Lite indicating system. It is claimed that the average operator is able to determine the required corrections for a rotor in less than half a minute on these machines. The machine will accommodate shaft sizes ranging from 1 1/2 to 3 3/4 inches in diameter. The heads can be adjusted along the bed to suit varying shaft lengths up to 4 feet.

A heavy type super-sensitive dynamic balancing machine known as Model NE-90 has been developed for handling work weighing from 200 to 10,000 pounds. 69



Machine Developed for Use in Balancing Automobile Generator Armatures

To obtain additional information on equipment described on this page, see lower part of page 162

Gisholt Turret Lathe Tools

Two new tools for turret lathes have recently been introduced to the trade by the Gisholt Machine Co., 1209 E. Washington Ave., Madison, Wis. One, an end-facing and forming tool, shown in Fig. 1, is used for facing, forming, and chamfering shafts, studs, bolts, screws, etc.; the second, shown in Fig. 2, is a pointing tool of similar construction, which provides a quick means of chamfering the ends of parts of the type mentioned for true starting on a single- or multiple-cutter turner.

Fig. 1. Gisholt End-facing and Forming Tool

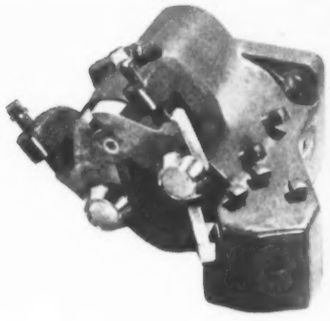


Fig. 2. Gisholt Pointing Tool for Turret Lathe

The rollers on each tool are mounted on needle bearings, and can be easily set for diameter to support the work accurately and rigidly. Substitution of a roller support assembly equipped with straight rather than bevel rollers converts the pointing tool into an end-facing and forming tool. Both tools can be used for light turning by substituting the proper cutter. Ample cutter room is provided in each case. 70

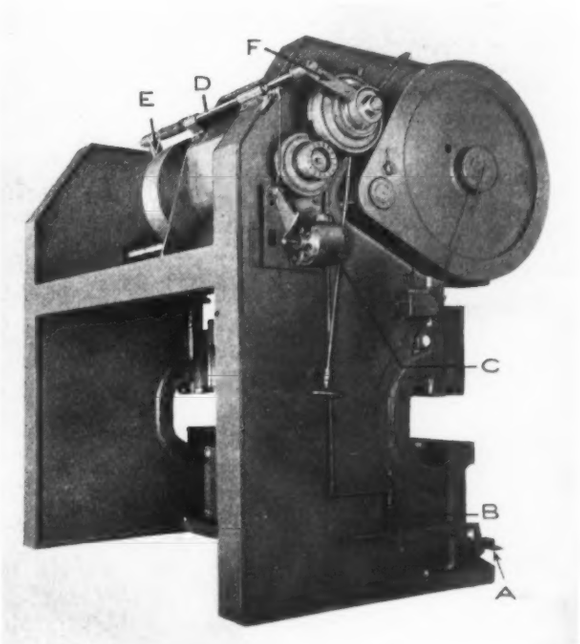
Clutch and Brake Mechanism for Steelweld Presses

The electrically operated clutch and brake mechanism here illustrated has recently been developed for Steelweld bending presses by the Steelweld Machinery Division of the Cleveland Crane & Engineering Co., Wickliffe, Ohio. This mechanism is designed to reduce the fatigue of the press operator by eliminating the physical effort required to engage the clutch manually. The foot need not be held on the treadle to keep the clutch engaged, although such an arrangement can be provided. Other features are fast clutch and brake action, as well as considerably reduced wear, due to decreased clutch and brake slippage.

The mechanism is started by depressing the foot-treadle *A*, which actuates the switch *B* and brings the torque motor *C* into play. Only a slight pressure of the foot is required to operate the treadle, since it merely closes the small switch indicated in the illustration. The gear segment is thereby brought to one extreme position or the other, depending upon whether the clutch or brake is being engaged. The illustration shows the brake engaged.

A shaft *D* connecting the clutch operating lever *E* with the brake operating lever *F* is worked by a connecting-rod from the gear segment through a toggle. The torque motor *C* is under power only when the clutch is engaged. When the power to the torque motor is cut off, a heavy spring on the clutch and brake connecting shaft *D* applies the brake. Thus, in case of power failure, the brake comes into action and the machine is stopped at once.

Depressing the treadle causes the clutch to become engaged and the brake disengaged; depressing it a second time disengages the clutch and engages the brake. With the clutch engaged, the press ram operates continuously until the treadle is depressed. An ingenious safety toggle insures positive operation of the mechanism and prevents the clutch or brake from being engaged or disengaged unintentionally.



Steelweld Bending Press Equipped with Electrically Operated Clutch and Brake Mechanism

While Steelweld bending presses of all sizes can be furnished with the electrically operated clutch and brake, this mechanism is particularly desirable for the larger machines that are used for forming plate 1/2 to 1 inch or more in thickness. The mechanism can be installed on most Steelweld presses now in service. The bending press shown in the accompanying illustration is known as the Model M6-10, and has a capacity for bending 10 feet of 3/4-inch steel plate between the end housings, or plate 12 feet 6 inches wide by 5/8 inch thick over the entire length of the bed and ram. 71

To obtain additional information on equipment described on this page, see lower part of page 162

Haskins Heavy-duty Flexible-shaft Machine

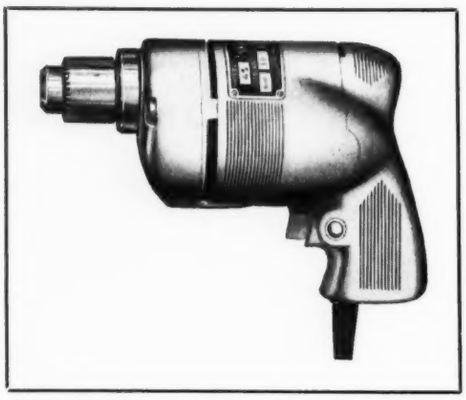
Haskins Truck-Mounted Flexible-Shaft Machine

The R. G. Haskins Co., 617 S. California Ave., Chicago, Ill., is now equipping its heavy-duty truck-mounted flexible-shaft machines with semi-pneumatic rubber tires, as shown in the accompanying illustration. The particular equipment shown is the Haskins HS-7, 1-H.P. unit. 72

Skilsaw Drill of Compact Light-Weight Design

A 1/4-inch electric drill known as the "Skildrill" has just been brought out by Skilsaw, Inc., 5033-43 Elston Ave., Chicago, Ill. Compactness, light weight, balance, and power make this new drill well suited for fast production drilling in aircraft, tank, automobile, refrigerator, and other industrial fabrication work.

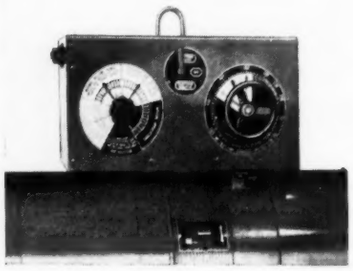
The "Skildrill" weighs only 2 3/4 pounds, is 6 5/8 inches long over all, and 2 9/16 inches wide. It fits comfortably in the palm of the hand, and can be used for drilling in tight spots. The body is die-cast. Anti-friction ball and needle roller bearings and helical cut gearing are used throughout. The universal motor of the equipment has a no-load speed of 1800 R.P.M. and a full load speed of 1050 R.P.M. 73



Light-weight Drill Made by Skilsaw, Inc.

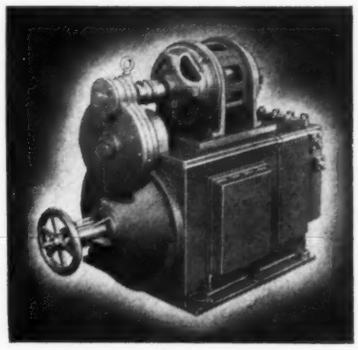
Lincoln Improved Arc-Welder Control

A simplified design of "Dual Continuous Control" for arc-welding machines has been developed by the Lincoln Electric Co., 12818 Coit Road, Cleveland, Ohio. The outstanding feature of this control is the elimination of volt and amperes meters. Welders equipped with this control have both the job selector and the current control calibrated, and are provided with dials that indicate the type of work and the number of amperes corresponding to each setting. It is claimed that this feature enables the operator to secure the highest quality welds and the highest possible welding speeds, because he can vary both the slope of the volt-ampere curve and the amount of welding current independently to suit each individual job.



Lincoln Current and Voltage Control for "Shield-Arc" Welder

Both the voltage control (job selector) and the current control are continuous in operation, providing an infinite number of possible combinations of voltage and current. This simplifies the setting of the control, and provides an exceptionally wide welding range with respect to types of work, welding conditions, size of electrodes, and thickness of work. 74



Variable-delivery Pump Built by Watson-Stillman Co.

Watson-Stillman Variable-Delivery High-Pressure Pump

A variable-delivery high-pressure pump is a recent addition to the line of "Stediflo" pumps built by the Watson-Stillman Co., Roselle, N. J. The volume of liquid delivered by this new pump is infinitely variable from 0 to 6 gallons per minute at a pressure of 5000 pounds per square inch. This variable delivery is obtained by a new driving member, mounted on the drive-shaft in such a manner that its angle can be varied while the pump is running, in order to produce a corresponding stepless change in the plunger stroke ranging from 0 to a full 4-inch stroke. The stroke control shaft is extended to the outside of the pump casing for attachment either to a manual or an automatic pressure control.

The pump is especially suited to hydraulic press applications where a rapid advance must be followed by a slow movement at high pressure, and for boiler feeds where sudden changes in output are required. It is equipped with a 25-H.P. motor, so mounted that the entire unit is but 4 feet high and requires a floor space 4 by 4 feet. The pump weighs 5000 pounds. 75

"Ritco" Rotary Forge Furnace

A rotary forge furnace embodying several new features for increasing production and reducing fuel costs has been brought out by the Rhode Island Tool Co., Providence, R. I. This furnace, available in 24- and 36-inch sizes, may

To obtain additional information on equipment described on this page, see lower part of page 162

be heated by bunker oil, No. 2 or 3 fuel oil, and natural or artificial gas. Fuel costs are said to average from 6 to 15 cents per furnace hour, depending on local fuel prices. The atmosphere in the combustion chamber can be controlled to prevent the formation of scale on the work. 76

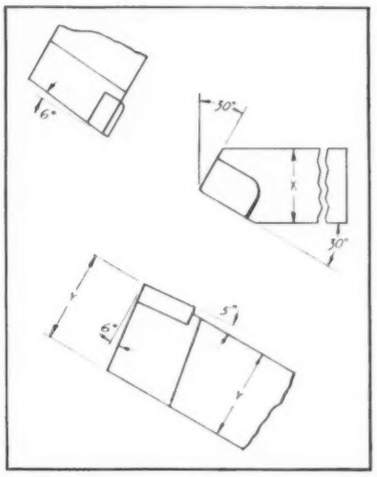
Jefferson Precision Milling Machine

A motor-driven, high-speed, precision milling machine, known as the "Bull-Dog," has been brought out by the Jefferson Machine Tool Co., Fourth, Cutter, and Sweeney Sts., Cincinnati, Ohio. This machine is available with power feed in either a floor or bench type, and also with quick-acting hand-lever feeds. It is adapted for such operations as die-sinking, contour profiling, angular milling, jig boring, routing of ferrous and nonferrous metals, and practically all kinds of milling operations within its capacity.

These machines are equipped with a collet having a capacity of 1/2 inch. The V-belt drive provides four speeds of 200, 400, 700, and 1000 R.P.M., the driving power being furnished by a concealed 1/3-H.P. motor, with drum type forward and reverse control.

The table has a longitudinal feed of 8 inches and the knee has a vertical movement of 5 3/4 inches. The maximum distance from the center to the table is 5 3/4 inches, and the working surface of the table is 14 1/2 by 4 3/8 inches. The over-all height of the floor type machine is 52 inches, and the weight 500 pounds. The weight of the bench type machine is 350 pounds. Equipment available for use on this machine includes a vertical-head milling attachment, a swivel vise, a plain vise, a dividing head, and a tilting type dividing head. 77

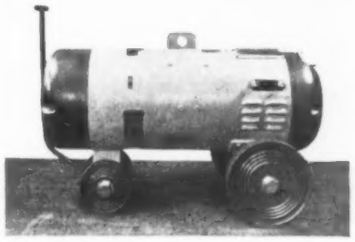
Jefferson Precision Milling Machine with Concealed Motor Drive



Kennametal Turning and Facing Tool with Raised Tip

Kennametal Large Size Turning and Facing Tools

A new series of Kennametal tools in large turning and facing styles for heavy machining work has been developed by the McKenna Metals Co., 147 Lloyd Ave., Latrobe, Pa. The raised position of the tip in the shank, shown in the accompanying illustration, provides for a greater thickness of steel under the cutting point of the tip and permits the top surface or the chip-breaker groove to be ground without the necessity of removing steel from the shank. With this design the height of the cutting point is retained during the life of the tool, not being lowered by grinding. These tools are made in all turning and facing styles, and in shank sizes of 1 inch and larger. 78



Westinghouse Flexarc Welder with Arc Control and Preset Current Adjustment

Westinghouse Portable Flexarc Welder

A portable Flexarc direct-current welder, known as the "Wemco," has been brought out by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., for all-purpose welding in industrial plants and shipyards, as well as for general maintenance work. The welder is finished in blue gray and has a one-piece weather-proof steel frame enclosure mounted on a four-wheel running gear. Capacity ratings are 200, 300, and 400 amperes for 220-, 440-, and 550-volt alternating-current circuits, two- and three-phase, 25, 50, and 60 cycles.

Current adjustment is obtained by means of a ball-crank which makes it possible to preset the machine for the desired current before welding. Steady current, regardless of arc length, is provided by arc control, which can be adjusted to suit the welding job.

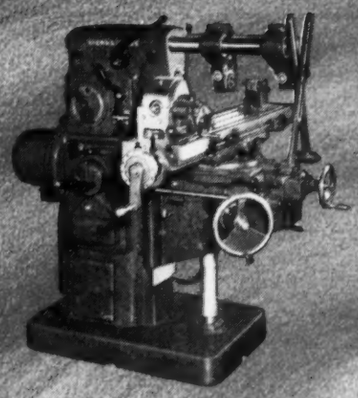
The driving motors are of the squirrel-cage induction type, with low starting current, high efficiency, and high power factor. A push-button controlled magnetic De-ion starter for the motor provides low voltage protection by separating the motor from the line if the line voltage is too low. A dual voltage coil on the starter permits operation from 220 to 440 volts without changing the contactor coil. Automatic burn-out protection is provided by a bimetal relay mounted on the motor stator windings. 79

Demagnetizer for a Varied Line of Work

A powerful portable demagnetizer has been brought out by the Ideal Commutator Dresser Co., 1011 Park Ave., Sycamore, Ill., for

To obtain additional information on equipment described on this page, see lower part of page 162

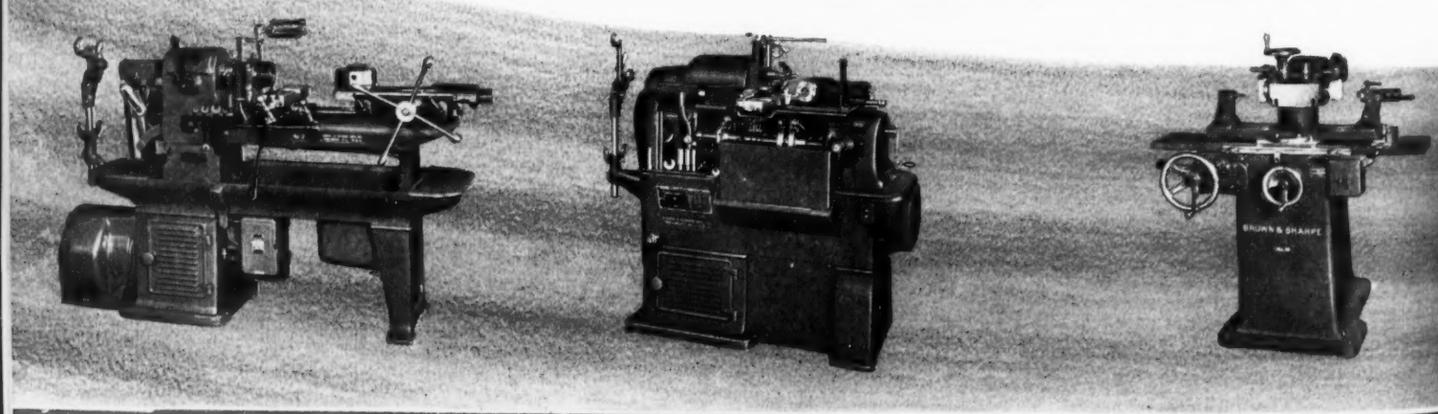
For Urgent National Defense Production . . . Today



. . with Accuracy and Dependability to serve Profitably on Future Needs in Manufacturing

Outstanding machines — notable for quiet and smooth operation • fast, safe control • and many other features giving high production and accuracy.

Brown & Sharpe Mfg. Co., Providence, R. I., U. S. A.



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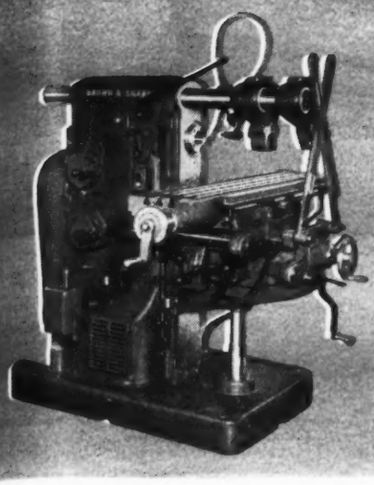
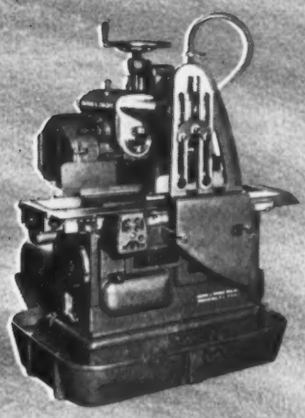
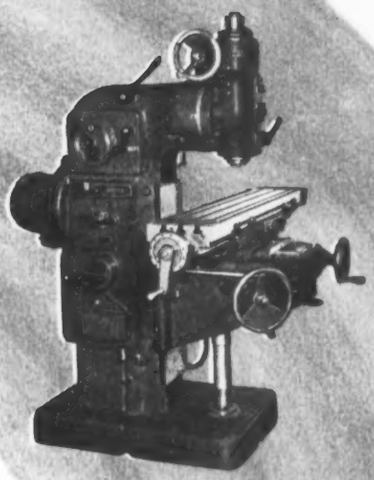






MILLING MACHINES

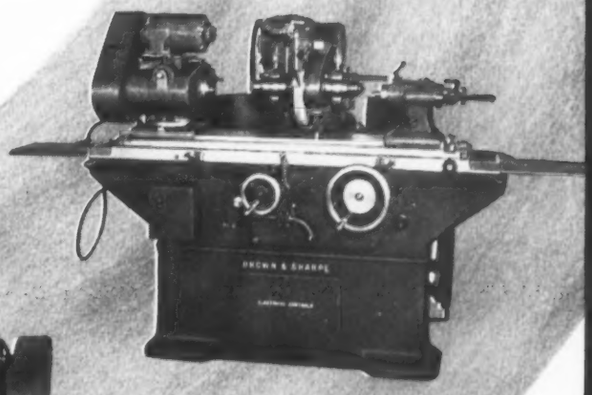
Universal — Plain — Vertical — Manufacturing

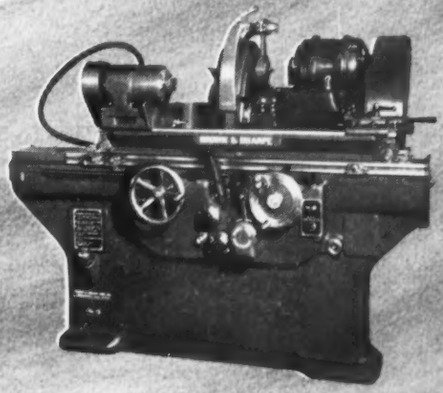
GRINDING MACHINES

Universal — Plain — Surface — Tool

SCREW MACHINES

Automatic — Wire Feed





B·S

SHARPE

the purpose of quickly demagnetizing tools, drills, punches, dies, and work held on magnetic chucks. Metallic dust, fine chips, etc., that cannot be wiped off clean with a rag are easily removed after a single pass across the magnetic poles. Large parts can be demagnetized in a similar manner, except that the demagnetizer, which weighs only 17 pounds and is easily handled, is moved over the heavy, bulky work. The demagnetizer has an indicating light which shows when the current is on. It is provided with an all-metal case. The size is 5 1/4 by 10 1/2 by 4 1/2 inches. 80

Williams Structural Box Pattern "Superrenches"

J. H. Williams & Co., 225 Lafayette St., New York City, have recently added a structural box pattern wrench to their line of chromium-molybdenum "Superrenches." The new wrench is designed to provide greater safety in structural work. The twelve-point box head is designed to insure a firm hold on the nut, and the offset type handle gives maximum clearance.

Williams Wrench Designed for Structural Work

The long tapered handle also provides ample strength and leverage, and can be used to advantage in lining up bolt-holes. These wrenches are available in six sizes, with openings 1 7/16 to 2 3/8 inches to accommodate U. S. standard nuts in sizes from 7/8 inch to 1 1/2 inches. They are forged from chromium-molybdenum steel, heat-treated, and finished in baked gray enamel. 81

General Electric Thyratron Tube for Industrial Use

A thyratron all-metal, negative-grid tube for general industrial applications, known by the designation GL-414, has been developed by the General Electric Co., Schenectady, N. Y. Since the tube has a shield grid, it is especially suitable for control circuits where the available grid power is very small, and where it is desirable to actuate the grid from a high-impedance source. The new tube is applicable for use in motor controls, welding controls, power rectifiers, and voltage regulators. 82

Controller for Spot-Welding

The making of a spot-weld is a precise process that must be rigidly controlled. A typical resistance welding cycle may last from 1/10 second to 3 or 4 seconds, depending on the kind and thickness of metal welded. The total welding time is further divided into various intervals during which the welding machine goes through its operating sequence.

The Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has developed a new controller for resistance spot-welding. This controller uses plug-in telephone type relays for compactness, and thyratron tubes to actuate them. The operator simply places the plugs in the proper holes in the panel of the controller. The controls are mounted on hinged dead-front panels, which can be swung open by removing a single bolt. 83

Crucible Steel Co. of America Awarded the Navy "E" Pennant

On November 25, the Atha Works of the Crucible Steel Co. of America, Harrison, N. J., were officially awarded the Flag of the U. S. Navy Bureau of Ordnance and the Navy "E" pennant for "excellence of performance in fulfilling naval ordnance contracts." The award was presented to A. E. Van Cleve, manager of the Atha Works, by Rear Admiral W. H. P. Blandy at a ceremony held in Library Park, Harrison, N. J., at which were present the officers and employes of the Atha Works, a large number of invited guests, and hundreds of citizens of Harrison.

With the Navy "E" award goes a special lapel button for every employe, bearing the name of the company, the insignia of the Bureau of Ordnance, and the Navy "E." At the presentation of the award, John Morgan, oldest payroll employe of the Atha Works, with a record of sixty years of service, was presented with the first button, pinned on his lapel by one of the officers of the Navy. Secretary of the Navy Knox, in citing the "E" award, made a statement to the effect that the award of the Navy "E" is the Navy's way of saying "well done."

* * *

Tracer Attachment on Milling Machine Hydraulically Actuated

In referring to the Hydrotel milling machine shown in Fig. 5 of the article relating to the Chrysler tank arsenal which appeared in December MACHINERY, it was stated that the cutter travels around irregular-shaped surfaces under the guidance of an electrical tracer device. This statement was in error; the tracer attachments on milling machines of the type mentioned are hydraulically actuated.

Compressed Air Institute Announces Prize Contest

The Compressed Air Institute announces a contest closing June 1, 1942, in which fourteen cash prizes will be awarded—one of $100, three of $50 each, and ten of $25 each—for the best articles dealing with compressed air and its use. In addition, there will be awards of $25 to all contestants who submit material acceptable for use in technical journals. The subject matter may be concerned with any use or phase of compressed air. The contest is open to any employe of organizations using or building compressed air equipment. The only exceptions are executives of companies comprising the Institute. For further information, address the Institute at 45 Warrington Place, East Orange, N. J.

* * *

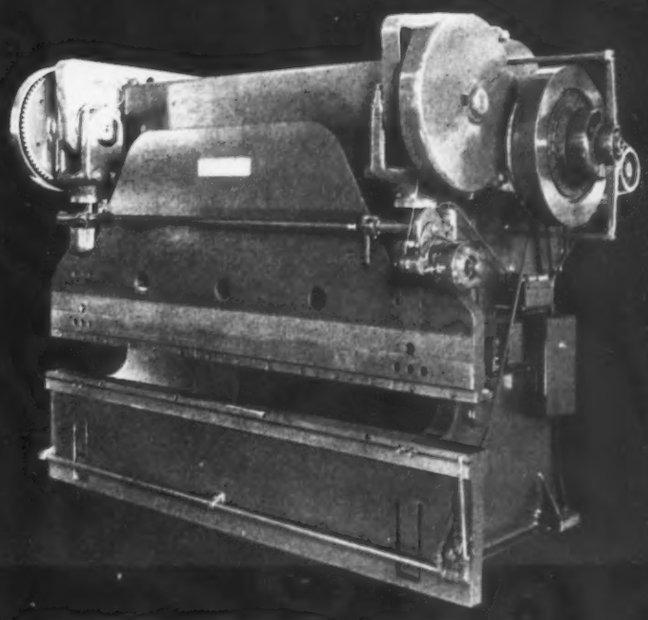
Definition: A committee is a group of men that keeps minutes and wastes hours.

To obtain additional information on equipment described on this page, see lower part of page 162

This Machine Works All the Time

Straightening billets is one of a great variety of important odd jobs done on this Cincinnati Press Brake in between high production runs of punching, forming, and notching operations.

Properly applied, a press brake has no "spare time." Write for recommendations on your range of work. Standard capacities from 75 through 1,000 tons.



Pioneers of the Steel Press Brake

THE CINCINNATI SHAPER CO.

SHAPERS · SHEARS · BRAKES

CINCINNATI, OHIO.

Some Points on Sub-Contracting in War Material Manufacture

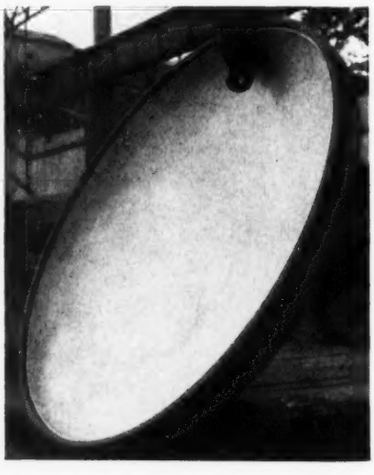
In a publication entitled "If You Want a Defense Contract," published by the Trundle Engineering Co., Bulkley Bldg., Cleveland, Ohio, the relationship between a prime contractor for war materials and his sub-contractor is discussed. It is pointed out that it is wise for a prime contractor to sub-contract a substantial share of the work rather than expand his present facilities. In many cases, several manufacturers have pooled their facilities, one of them being designated as the prime contractor. This has the advantage of greater security to the Government in the fulfillment of the contract according to specifications and delivery dates, and, at the same time, brings more companies into active participation and reduces to a minimum the necessity for new manufacturing facilities.

The prime contractor should organize to give the sub-contractor whatever assistance is necessary to assure that the work will be completed in accordance with specifications and delivery dates conforming to the prime contractor's schedule, and at the same time produced at the minimum cost (keeping in mind that no sub-contractor, or prime contractor either, for that matter, will be a satisfactory source of supply unless he can make ends meet).

The prime contractor should furnish to his sub-contractors either the gages or the design of gages conforming with those he is using, so as to assure proper functioning of the materials and adherence to specifications. The prime contractor should keep in contact with the sub-contractors, and be ready and willing to render all necessary assistance. Better coordination and cooperation between the prime contractor and the sub-contractor is accomplished by each assigning one man for contact between the two companies.

It is often found that even the sub-contractor has to sub-contract. Therefore, the prime contractor must become interested and cooperative with the sub-contracting of the sub-contractor—all to one end, that all production will be performed in accordance with specifications and will be timed to meet the assembly schedules called for by the Government. To summarize:

1. See that the sub-contractor is supplied with full and complete drawings, specifications, and information about each job.
2. The prime contractor should use his own men to help get production started in the sub-contractor's plant.
3. The chief inspector of the prime contractor should see that the sub-contractor is properly instructed in the use of gages, and should check the sub-contractor's gages periodically with the prime contractor's master gages.
4. The prime contractor should provide inspection, in addition to the sub-contractor's inspection, inside the latter's plant. Defective parts should not be permitted to accumulate.



One of Eighteen Flanged and Dished Heads, 6 Feet in Diameter, 1 5/16 Inches Thick, Produced by the American Locomotive Works, Dunkirk, N. Y., from the Jessop Steel Co.'s "Silver-Ply" Stainless-clad Steel

Paint Substitute for Zinc Coatings

During the war emergency, it becomes necessary to turn from accepted materials to substitutes. This has been particularly true of metals. No metal is more widely used for protective purposes than zinc. It is also needed for alloys and materials used in the war industries. With the growing intensity of our war effort, conservation of zinc, therefore, becomes increasingly important.

Substitution of paint for galvanizing wherever possible is a direct contribution to victory. The selection of the proper substitutes is discussed in a bulletin "Substitution of Paint Coatings for Metallic Zinc Coatings," prepared by E. F. Hickson, chemist of the Bureau of Standards, Washington, D. C. A limited number of copies of this bulletin are available upon application to the Specifications Branch, Bureau of Industrial Conservation, Office of Production Management, Social Security Bldg., Washington, D. C.

* * *

Bethlehem Steel Co. Receives Safety Award

The National Safety Council Award for 1941 was presented to the Bethlehem plant of the Bethlehem Steel Co. at a dinner held in Bethlehem, Pa., Thursday, December 11. The trophy, awarded annually to the plant having the lowest lost-time accident rate in its group, was won by the Bethlehem plant in competition with twenty-two other large steel plants, all averaging 750,000 man-hours or more per month. The Bethlehem Steel Co. won by having only 1.99 lost-time accidents per million man-hours, based on a yearly total of 39,683,231 man-hours. This was not only an all-time low for the plant, but was also a record for the steel mill group.

The achievement is all the more significant in view of the large number of new and inexperienced men hired during the contest period. The progress of the safety work in the Bethlehem plant is indicated by the fact that, during the contest period, the accident frequency rate was only one-seventh what it was ten years ago.

The Cincinnati Bickford

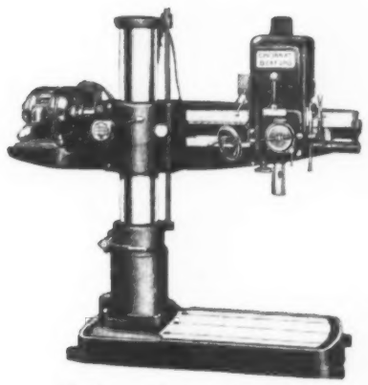
SUPER SERVICE

Upright and Radial

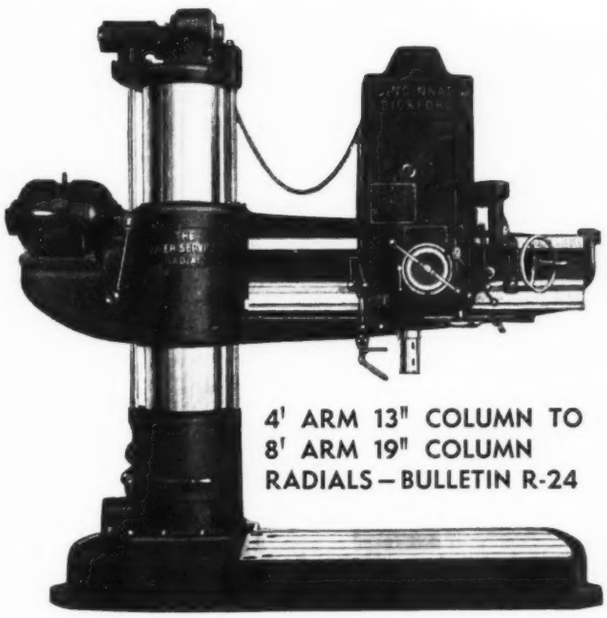
METAL DRILLING MACHINERY

Productivity, Capacity, Adaptability, Reliability, Accuracy, Convenience and Economy are the intangible components that give the Cincinnati Bickford line of drills the appropriate name of SUPER SERVICE.

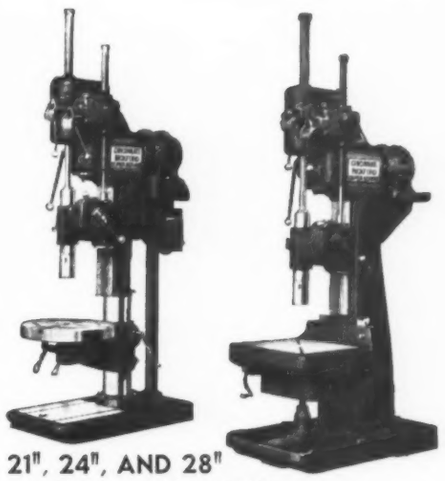
Examine the possibilities of the machines shown here and for further information send for any or all of the Bulletins pertaining to the machines that interest you.



3' OR 4' ARM RADIAL
WITH 9" COLUMN
BULLETIN R-21-A



4' ARM 13" COLUMN TO
8' ARM 19" COLUMN
RADIALS—BULLETIN R-24



21", 24", AND 28"
ROUND AND BOX
COLUMN UPRIGHTS
BULLETIN R-25

THE CINCINNATI BICKFORD TOOL CO.

OAKLEY, CINCINNATI, OHIO, UNITED STATES OF AMERICA

Allis-Chalmers Expands Safety Program

The Allis-Chalmers Mfg. Co., Milwaukee, Wis., has intensified its safety activities as an aid to the nation's war production efforts. This is in line with a similar program advocated throughout industry. The first step in the campaign was the distribution of 14,000 copies of a new illustrated safety manual to the employes at the West Allis plant. The pamphlet contains special instructions for the care of the eyes, hands, and feet. Wide use of standard safety goggles and steel-toe safety shoes is advocated.

Included is a guide to the company's hospital facilities, where eight nurses, six first-aid men, and eight doctors provide 24-hour-a-day free medical service to all employes. The staff administers all first-aid and prescribes the proper follow-up treatment for each case.

About seventy-five newly erected glass enclosed bulletin boards will carry periodic safety messages as the campaign continues. From time to time the company will supplement the manual on general occupational safety with specific information on individual job hazards where necessary. Essential safety equipment is furnished by the company without cost.

Government to Aid Industrial Training

In connection with the urgency for continuing apprentice training programs, the Apprenticeship Section of the Division of Labor Standards, Department of Labor, Washington, D. C., is planning to appoint some 200 field representatives to be stationed throughout the country. The Federal Civil Service Commission has announced an examination, in which applicants for this work will be rated on the extent and quality of their experience only. The positions pay from $2600 to $4600 a year.

These field representatives are expected to develop national, statewide, and local apprenticeship standards for various occupations. Working in cooperation with union, industrial, and governmental officials, they are to promote programs for training young men and women for industrial work. Applicants are particularly sought who are qualified in the machine shop trades, and in aircraft and shipbuilding. Prospective applicants can obtain further information by applying to the U. S. Civil Service Commission, Washington, D. C., or to any first- or second-class post office throughout the country. Applications must be filed not later than January 12.

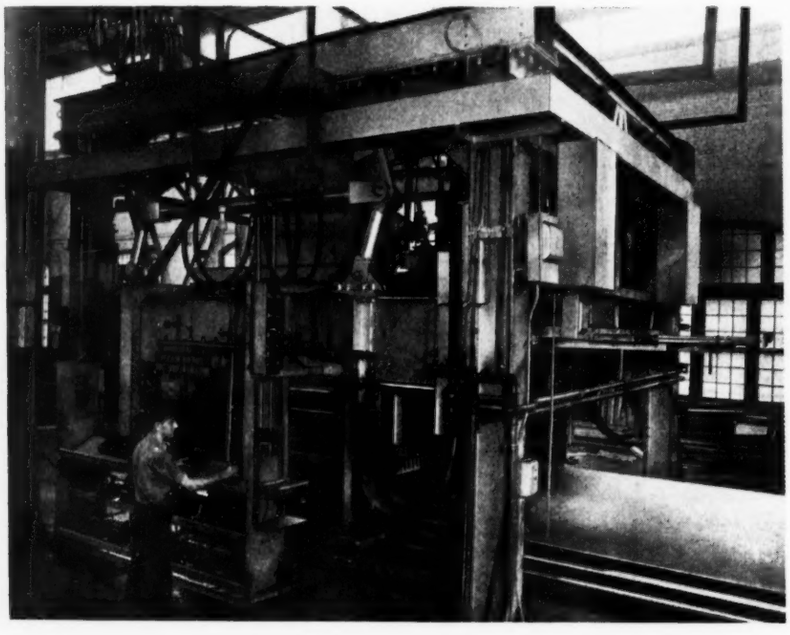
Industrial Motion-Picture Films

The University of Iowa has prepared a number of motion-picture films on industrial subjects that are being made available to industry and educational institutions at a small rental charge. Further information relating to these films can be obtained from the Department of Visual Instruction, Extension Division, State University of Iowa, Iowa City, Iowa.

Among the films available are the following: Assembly of Small Parts; Forging and Machine Shop Operations; Forming Links for Portable Typewriters; Soldering and Small Assembly Operations; Motion and Time Study Principles; and a Study of the Development of Skill During the Performance of a Factory Operation.

* * *

The Committee of Public Relations of the Eastern Railroads, 143 Liberty St., New York City, has published the 1941 edition of "A Year-Book of Railroad Information," containing a great deal of data on railroad operation—mileage, rolling stock, passenger and freight traffic, maintenance expenses, taxes, employes, wages, and kindred information.



Four Hundred Freight Cars can be Constructed Each Month with This Giant Spot-welding Machine which Stitches Steel Parts together. The Operator Merely Pushes the Buttons of a Westinghouse Control Apparatus, which Sends 20,000 Amperes of Electric Current through 75 Welding Electrodes in Rapid Succession to Weld Parts of the Sides or Top of a Freight Car

A COMBINATION HARD TO BEAT

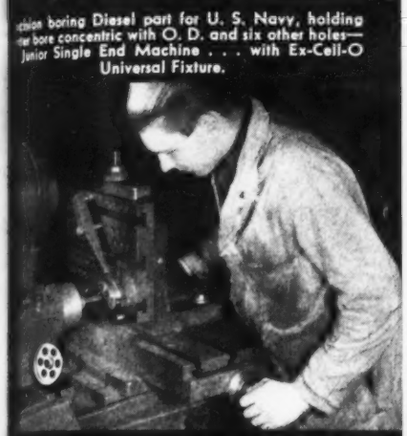
. . . for precision boring, turning and facing in miscellaneous lots

EX-CELL-O STANDARD BORING MACHINES and UNIVERSAL FIXTURES

MANUFACTURING plants and machine shops with a variety of jobs in different size lots can bore, turn, face and groove with extreme precision in size and finish—with the utmost economy and at a high production rate—by the use of an Ex-Cell-O *standard* Precision Boring Machine and an Ex-Cell-O *standard* Universal Fixture. The same precision in design and operation that makes the Ex-Cell-O Boring Machine a superior machine tool also features the Ex-Cell-O Universal Fixture—used together they are practical and profitable. These two standard Ex-Cell-O products are solving problems for many manufacturers—small and large—whose work calls for the speedy turning out of a variety of parts, with all the advantages that come with the use of single point diamond or carbide tools. The flexibility in application of the Ex-Cell-O Universal Fixture makes it well worth your consideration at this time.

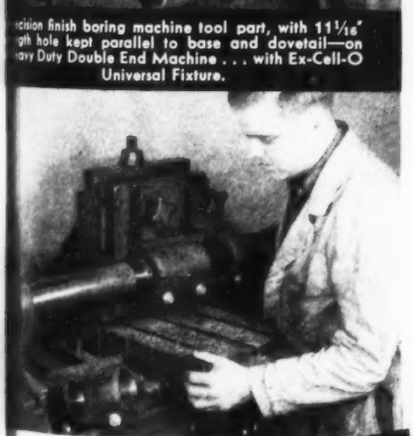
EX-CELL-O CORPORATION • DETROIT, MICHIGAN

cision boring and facing airplane engine part, with tionship between shoulders and flange rigidly held n Junior Double End Machine . . . with Ex-Cell-O Universal Fixture.

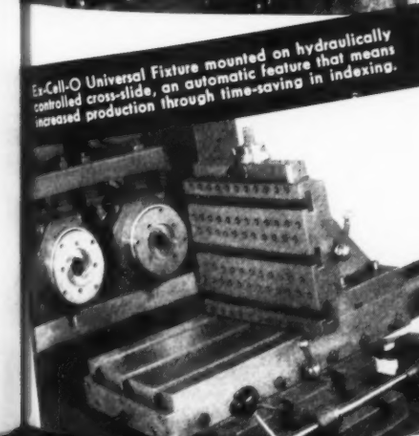


cision boring Diesel part for U. S. Navy, holding ter bore concentric with O. D. and six other holes— Junior Single End Machine . . . with Ex-Cell-O Universal Fixture.

cision boring aircraft part to limits of ±.0002" and ding distance between large and small holes to reme exactness—on Junior Single End Machine . . . with Ex-Cell-O Universal Fixture.



cision finish boring machine tool part, with 11 1/16" gth hole kept parallel to base and dovetail—on avy Duty Double End Machine . . . with Ex-Cell-O Universal Fixture.



Ex-Cell-O Universal Fixture mounted on hydraulically controlled cross-slide, an automatic feature that means increased production through time-saving in indexing.

Precision THREAD GRINDING MACHINES

•

Precision BORING TURNING and FACING MACHINES

•

Precision LAPPING MACHINES

•

Precision GRINDING SPINDLES

•

Precision CARBIDE TOOL GRINDERS

•

Precision HYDRAULIC POWER UNITS

•

Precision CUTTING TOOLS

•

Precision BROACHES

•

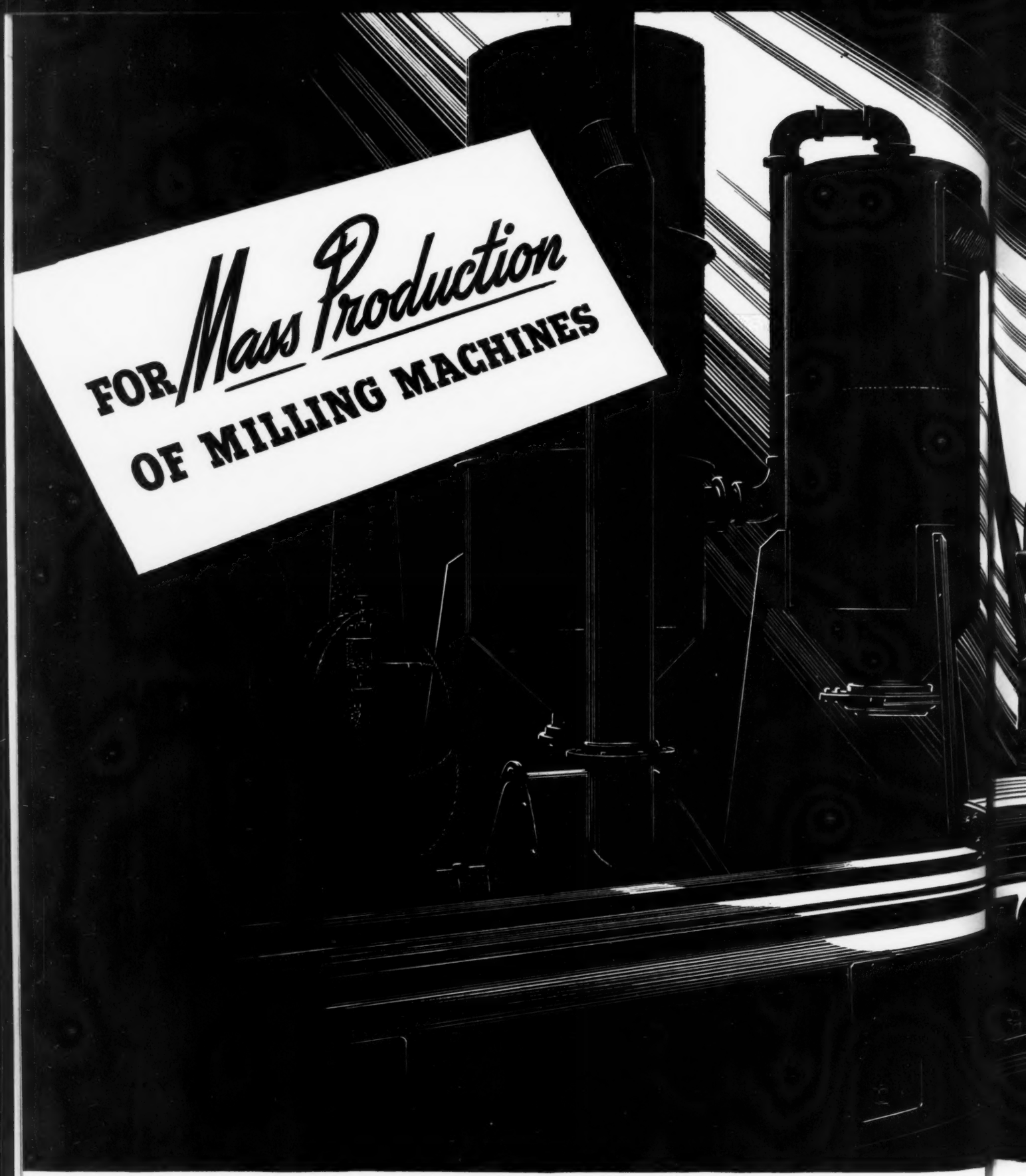
Precision DRILL JIG BUSHINGS

•

Precision PARTS

XLO

EX-CELL-O *means* PRECISION



Specialized machines—modern marvels of engineering — are a basic part of the carefully planned and coordinated production facilities, functioning a full 168 hours per week, which make it possible to manufacture Milwaukee Milling Machines in volume to the highest standards of machine-tool precision and quality.

This 15 ton, seven-spindle production unit was designed for machining T Slots in milling machine tables. It eliminates five independent cuts and increases production by more than 550% over ordinary methods. But what is most important — it insures a higher degree of accuracy than was previously obtainable.

Milwaukee MILLING

The full production capacity of our plants, the largest in the world devoted exclusively to the manufacture of milling machines . . . is dedicated to national security.

KEARNEY & TRECKER CORPORATION
MILWAUKEE, WISCONSIN, U. S. A.

KEARNEY & TRECKER
CORPORATION
Milwaukee
MILLING MACHINES

One of a series of advertisements describing specialized machines — originated, designed and built by Kearney & Trecker Corp. to assure the quality of Milwaukee Milling Machines under mass production.

MACHINES • • • •

Cutting Out Ship Plates by the Oxy-Acetylene Method

Many steel plates that are later to be electrically welded or riveted together in the construction of ships are cut to the required outlines at the New York Shipbuilding Corporation, Camden, N. J., by means of automatic oxy-acetylene cutting equipment. In the illustration is shown a machine of this type made by the Air Reduction Sales Co., which is being employed on a typical operation, consisting of cutting to a straight line under the guidance of a track on which the machine runs. This equipment is used for cutting steel plate up to about 8 inches thick. The cutting speeds employed on plates 3/8 inch in thickness are customarily 2 feet a minute.

Automatic Oxy-Acetylene Machines are Used in Cutting Many Ship Plates to Straight and Curved Outlines, Ready for Fabrication by Welding

How Timken Roller Bearing Co. Promoted the Sale of Defense Savings Stamps

In a four-day campaign, the Timken Roller Bearing Co., Canton, Ohio, sold some $36,500 worth of Defense Savings Stamps. Advantage was taken in the campaign of the sales appeal of eight attractive girl employes. The young ladies were costumed in specially designed red, white, and blue outfits, and sold Defense Savings Stamps in the offices, as well as on the streets. Headquarters for the campaign were set up in a booth on the Courthouse Square of the city, from where the Timken company sponsored daily radio broadcasts advertising the campaign. Full-page advertising in the local newspapers also helped to arouse public interest. The campaign was carried out at a nominal expenditure on the part of the company. With this start, the savings program is being carried on in Canton under the supervision of the Ohio State Defense Savings Committee.

Industrial Course for Graduate Engineers

A new phase has been inaugurated in the training program for the 140 graduate engineers now enrolled in the two-year course for graduate engineers maintained by the Allis-Chalmers Mfg. Co., Milwaukee, Wis. The course has been expanded to include classroom instruction four hours a week during thirty-six weeks of the year. Lectures and instruction are given by Allis-Chalmers executives, department managers, chief engineers, superintendents, and supervisors. The classroom work, which supplements the actual experience in the shops and other departments of the company, is divided into four basic subjects: Psychology as applied to business; sales methods; company organization and policy; and engineering of Allis-Chalmers products. Certificates for completing the post-graduate training courses maintained by the company are presented at the end of the course.

* * *

Speeding Production of Turbine Blades by Broaching

At the South Philadelphia plant of the Westinghouse Electric & Mfg. Co., a large vertical broaching machine has been adapted to turbine-blade manufacture to help speed up production. This machine does the work formerly performed by four machines, and does it five times faster. The machine cuts or shapes twenty-five surfaces at once in a 10-second operation. An important gain in production at the present time is also represented by the release of the other machine tools and of the men who operate them, for other work.

The steel blanks for the turbine blades are fed into the machine at the rate of 70 per hour. All that the operator does is to touch the button controls that start the ram which actuates the movement of the broach.

* * *

Success in the thing you can do is better than useless striving for something beyond your reach.—*The Houghton Line*

STOP ALL THE WASTE OF OLD-TIME METAL CUTTING

★ WASTE OF TIME
★ WASTE OF POWER
★ WASTE OF LABOR
★ WASTE OF ENERGY
★ WASTE OF METAL

4 Corners Cut in 4 Hours

With the DoAll a 4½" x 2½" cut was made in each corner of this 18" - thick, 945 - pound MO - LYB - DIE Hardtem B block. It took only one hour to notch each corner. The saw cut very straight and the job turned out beautifully.

Lansing Drop Forge Co., Lansing, Mich.

12 Hours 40 Minutes Saved

Four pieces of Water Hardening Tool Steel 2" x 10" x 11" formerly done on shaper in 14 hours, now sawed on the DoAll in 1 hour and 20 minutes.

Swanson Tool & Machine Co., Erie, Pa.

SAVE with the DoAll

This ultra-modern machine tool offers you the fastest, most efficient way of removing metal, any kind, from hardest high carbon steel to soft brass. Does internal and external band sawing, filing and polishing. The DoAll cuts corners all along the line—takes the place of shaper, milling and lathe work in industrial and defense plants everywhere.

Let us send a factory trained man to your plant to demonstrate just what a DoAll can save you.

FREE—Literature and 158-page Handbook on Contour Machining. Send for copy today.

CONTINENTAL MACHINES, INC.
1312 S. Washington Ave. MINNEAPOLIS, MINN.

Associated with the DoAll Company, Des Plaines, Ill., Manufacturers of Band Saws and Band Files for DoAll Contour Machines.

NEWS OF THE INDUSTRY

Florida and Georgia

LINCOLN ELECTRIC CO., 12818 Colt Road, Cleveland, Ohio, manufacturer of arc-welding equipment, has opened a new office in Jacksonville, Fla. J. M. CHAPPLE, who until recently was with the Detroit office of the company, and who for two and one-half years was managing director of the Lincoln Electric Co. (Australia) Pty., Ltd., at Alexandria, will be in charge of the new branch. The address of the Jacksonville office for the present will be care of Union Terminal Warehouse, 700 E. Union at Ionia.

W. P. CHILDS, 845 Memorial Drive, S.E., Atlanta, Ga., has been appointed representative of the Progressive Welder Co., Detroit, Mich., manufacturer of resistance welding equipment.

Michigan

CARBOLOY COMPANY, INC., Detroit, Mich., announces the centralization of its sales engineering department under K. R. BEARDSLEE, sales manager. Two posts of assistant sales manager have been created which will be held by MARTIN MUHLING, former special engineering executive, and EARL GLEN, previously Pittsburgh representative. R. R. PRESTON, formerly superintendent of the wire mill at the Page Steel & Wire Co., succeeds Mr. Glen as Pittsburgh representative.

VERNOR ENGINEERING CO., 2280 Fourteenth St., Detroit, Mich., was recently organized to render a complete engineering service to all branches of the defense industry. The new company specializes in the design of jigs, fixtures, tools, dies, gages, and special machines, in plant lay-outs, and in the solution of production problems. The head of the firm is CHARLES W. DOWNS, who has been actively engaged in tool engineering in Detroit with leading companies for over twenty-five years. Associated with him is JOHN MAYVILLE, formerly chief tool designer of the Kelsey-Hayes Wheel Co., and until recently assistant chief tool designer at Vickers, Inc.

ALLIANCE ENGINEERING CO., designer of tools, dies, and special machinery, has moved from 6317 Ellsworth Ave., Detroit, Mich., to larger quarters at 8516 Fenkell Ave. RUDOLPH W. KROY has been appointed general manager of the company. He has been in the automobile business for fifteen years, engaged in designing tools.

MANUFACTURERS ENGINEERING SERVICE CO. announces its removal to larger quarters in the C. P. A. Building, 14th and Michigan Aves., Detroit, Mich. The company specializes in the design of tools, dies, jigs, fixtures, and special machinery for tanks, guns, and airplane parts.

O. W. YOUNG, formerly general manufacturing manager of the Buick Motor Division of General Motors Corporation, Flint, Mich., has been made executive assistant to the general manager, Harlow H. Curtice, and will have charge of all manufacturing operations, both automotive and defense.

JACKSON PRODUCTS, manufacturers of electric welding electrode-holders and eyeshields, now occupy a new factory at 3265 Wight St., Detroit, Mich., which affords greatly increased production facilities.

JAMES B. HAYDEN has been elected vice-president in charge of sales of the Industrial Brownhoist Corporation, Bay City, Mich.

Missouri

H. A. HUDSON, formerly manager of the Motor Sales Division of the Wagner Electric Corporation, 6400 Plymouth Ave., St. Louis, Mo., has been promoted to the position of manager of sales of the Electrical Division.

H. A. Hudson, Manager of Sales, Electrical Division of Wagner Electric Corporation

DESPATCH OVEN CO., Minneapolis, Minn., manufacturer of industrial ovens, furnaces, air heaters, etc., has appointed the SHEA-BROWNELL CO., 3908 Olive St., St. Louis, Mo., exclusive representative of the company in the Missouri territory.

New England

IRVING C. EATON, assistant engineer of the Bridgeport, Conn., laboratory of the General Electric Co. since 1930, has been appointed engineer, succeeding E. W. SCHWARTZ, who has resigned.

SPARKS MACHINE TOOL CORPORATION announces its removal to new sales and engineering offices at 32-34 Main St., Norwalk, Conn.

JOHN C. GARAND, of the Springfield Armory, Springfield, Mass., has received the Holley Medal of the American Society of Mechanical Engineers "for his invention and development of the semi-automatic rifle which bears his name and has been adopted by the United States Army, and is a distinct contribution to our national defense."

New Jersey

J. E. VON MAUR has been appointed representative of the American Gas Furnace Co., Elizabeth, N. J., in the southern Ohio district, with office at 63 S. High St., Columbus, Ohio. It is also announced that EARLE S. DUDLEY has succeeded W. F. FABER as representative of the company in eastern New York State.

ENGINEERING TOOL SALES CO., 17 Bentley Ave., Jersey City, N. J., has been organized as a selling agency for a number of machine tool and accessory items. H. W. Shertzman is sales manager.

New York

HAROLD C. RICHARDSON, assistant superintendent of the Porter-Cable Machine Co., Syracuse, N. Y., manufacturer of sanding machines, edgers, and electric hand saws, has been given an extended leave of absence to fill a position in the New York City Division of Contract Distribution for Army Ordnance of the United States Office of Production Management.

JOSEPH A. SULLIVAN, assistant publicity manager of the Chicago Pneumatic Tool Co., 6 E. 44th St., New York City, has been promoted to the position of advertising manager.

THE STORY OUR ADVERTISEMENTS DO NOT TELL

The advertisements of The New Jersey Zinc Company which are appearing currently in these pages explain the reasons why non-defense consumers have not been able to obtain all of the zinc they would like to have.

At the close of a critical business year, however, The New Jersey Zinc Company feels that it should tell a story which would not normally be a part of such a series of advertisements—a story of the cooperation given to this Company by its customers.

This cooperation, and the resulting exchange of vital information, made possible:

A better understanding of our mutual problems and difficulties;

The elimination of unreasonable demands and unfilled promises;

The fulfillment of contract obligations in spite of a tremendous expansion of business;

The shipment of a large list of zinc products where and when they were needed most—in defense and non-defense fields.

Consequently, thanks to our customers' cooperation and understanding, we feel that a difficult task has been accomplished.

The New Jersey Zinc Company looks forward to 1942 with confidence that this cooperation—which has proved of the greatest value under a heavy strain—will continue to operate to the mutual advantage of all concerned.

160 FRONT STREET

New Jersey zinc

NEW YORK, N. Y.

Ohio

REPUBLIC STEEL CORPORATION, at its Canton Works, has completed a new metallurgical laboratory which is considered one of the most outstanding in the country. This laboratory has a staff of 125 people. A sample of every heat of steel is examined in this laboratory. Raw materials are tested and research work carried on with a view to improving present products and developing new ones.

BUNTING BRASS & BRONZE CO., Toledo, Ohio, announces the removal of two sales offices and warehouses. The Atlanta, Ga., office was moved into new quarters at 542 Spring St., N.W., and the Kansas City office was moved to 1821 McGee St.

RELIANCE ELECTRIC & ENGINEERING CO., Cleveland, Ohio, has purchased the plant of the Cleveland Hobbing Machine Co. The acquisition of this plant will make available approximately 31,000 square feet of additional floor space.

Pennsylvania

T. I. PHILLIPS was elected a vice-president of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., at a recent meeting of the board of directors. Mr. Phillips started with the company as a toolmaker in 1915, and has been assistant to the president since February of last year, previous to which he served as works manager.

T. I. Phillips, New Vice-president of the Westinghouse Electric & Mfg. Co.

R. V. Mann, General Sales Manager of the Carpenter Steel Co.

R. V. MANN, who has been assistant to the president of the Carpenter Steel Co., Reading, Pa., has been made general sales manager. Mr. Mann joined the Carpenter organization in 1911. Six years later—in 1917—he resigned to enter the U. S. Army. In 1925, he returned to the company as assistant to the president, in which capacity he supervised the sales of stainless steel. O. V. GREENE, assistant metallurgist of the company, has been made manager of tool steel sales. Mr. Greene has been associated with the company since 1928; previous to that, he was metallurgist with the Reading Railroad Co.

KEYSTONE CARBON CO., St. Marys, Pa., manufacturer of commutator and slip ring brushes, porous bronze bearings, negative temperature coefficient resistors, and electrical contacts, has opened an eastern sales office at 249 High St., Newark, N. J. ROBERT MCKEOWN and CHARLES V. ALLEN are district representatives, succeeding the late E. A. Berger, sales engineer. A. A. BARBERA & CO., 417 S. Hill St., Los Angeles, Calif., has been appointed representative for Keystone products in the Southern California territory.

C. E. HERINGTON has been appointed sales director of a newly created sales service department established by the Meehanite Research Institute of America, Inc., Pittsburgh, Pa. The object of the department will be to provide assistance in the solution of selling problems encountered by Meehanite manufacturers in the United States and Canada. Mr. Herington, formerly advertising manager, will continue to supervise Meehanite promotional activities.

E. F. HOUGHTON & CO., Philadelphia, Pa., manufacturers of oils, leathers, and metal-working products, held "open house" for stockholders and customers on December 11, to mark the completion of the company's new office building. This building is a three-story structure of glass-block construction, completely air-conditioned. It represents only a part of the company's expansion program.

O. V. Greene, Manager of Tool Steel Sales, Carpenter Steel Co.

WILLIAM S. WILBRAHAM, manager of sales of Lukenweld, Inc., Coatesville, Pa., has been promoted to the position of manager of costs. ROBERT C. SAHLIN, assistant manager of sales, will succeed him as manager of sales.

C. E. Herington, Recently Appointed Sales Director of Meehanite Research Institute

NEED FASTER TOOL "DELIVERIES"?

THIS DEFENSE SUB-CONTRACTOR GETS SPECIAL TOOLS ON JOBS In Less Than 1 Hour!

West Bend Aluminum Co. Keeps Carboloy Standard Tools In Crib; Quickly Grinds Special Shapes Needed

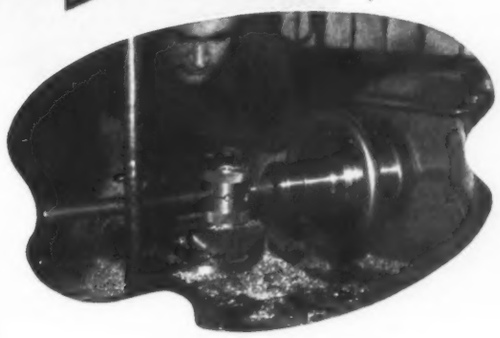
No delays awaiting "special" carbide tools at West Bend (Wisc.) Aluminum Company!

This former aluminum kitchenware manufacturer, now producing sub-contract defense parts, gets "special" Carboloy tools on the job in less than one hour by this simple method:

They maintain in their tool crib a nominal stock of Carboloy Standard tools in 5 styles, 10 sizes (a total of 10 basic tools). From these "Standards," West Bend quickly grinds their own special shapes to meet 75% of all tooling requirements in their plant! To grind any of the special shapes used (15 shown above) is a matter of minutes. Weeks of waiting are thus often avoided.

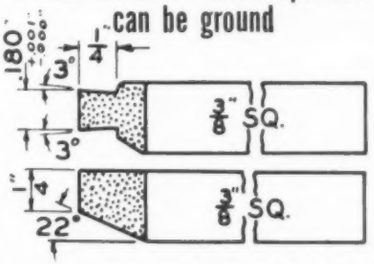
***Carboloy Standard Tools, available in 10 styles for cutting steel, cast iron and non-ferrous metals, are adaptable to 60%-80% of all turning, facing, boring operations. Manufactured in mass production quantities, Carboloy "Standards" are always available for faster delivery than Carboloy special tools. Keep a nominal supply in your crib for current needs . . . grind them to meet your special requirements . . . and you'll save weeks of delivery time on "specials" under present conditions. Write for standard tool and blank catalog GT-129.

CARBOLOY COMPANY INC., 11147 E. 8 MILE BLVD., DETROIT, MICH.
Chicago • Cleveland • Los Angeles • Newark • Philadelphia • Pittsburgh
Worcester, Mass.
Canadian Distributor: Canadian Electric Co., Ltd., Toronto, Canada

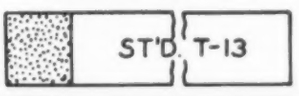


NO LONG DELAYS WAITING FOR SPECIAL TOOLS ON *THIS* DEFENSE JOB!
To turn, face, bore these Ampco bronze airplane landing gear bearings, West Bend Aluminum Co., quickly grinds special shapes from Carboloy Standards in its tool crib.

TOOLS FOR ABOVE JOB:
In 55 minutes these specials can be ground



. . . from this Style No. 1 Carboloy Standard Tool



CARBOLOY

Reg. U. S. Pat. Off.

STANDARD STOCK BLANKS
2 STYLES • 65 SIZES • 3 GRADES

Texas

E. R. Goss has been made branch manager of the El Paso, Tex., office of the Chicago Pneumatic Tool Co., 6 E. 44th St., New York City. Mr. Goss succeeds E. J. Coughlin, who was killed recently in an automobile accident.

Washington, D. C., and Virginia

NEW DEPARTURE DIVISION GENERAL MOTORS CORPORATION, manufacturer of ball bearings, announces the opening of a new office at Washington, D. C., in the National Press Bldg., Room 747. ALWIN A. GLOETZNER is special representative in charge.

ROGER VERNON TERRY, assistant chief engineer of the Newport News Shipbuilding & Drydock Co., Newport News, Va., has received the Melville Medal of the American Society of Mechanical Engineers for his paper "Development of the Automatic Adjustable-Blade Type Propeller Turbine," presented at the 1940 annual meeting of the Society. This is one of the Society's major awards.

* * *

Aircraft Engine Standards

Forty-two aircraft engine standards were recently approved by the Aeronautics Division of the Standards Committee of the Society of Automotive Engineers. These standards can be obtained by application to the Society's headquarters, 29 W. 39th St., New York City.

OBITUARIES

STUART JUDSON MARBLE, manager of the industrial department, New York district sales, of Revere Copper and Brass Incorporated, died on November 24 at the Gotham Hospital in New York, following a brief illness. Mr. Marble was born in Meriden, Conn., on August 11, 1890. After graduating from the Meriden High School, he entered the New York office of the Chase Brass & Copper Co. In 1912, he became affiliated with the New York office of the Rome Brass & Copper Co. which, in 1928, was consolidated with five other companies to form what ultimately became Revere Copper and Brass Incorporated. Prior to the consolidation, Mr. Marble was made manager of the New York office of the Rome Brass & Copper Co., and had held the position he occupied at the time of his death since the consolidation. He is survived by his daughter, Lois J. Marble.

GUY F. STRAFER, manager of the Kansas City district office of the Allis-Chalmers Mfg. Co. since 1923, died on November 23 at St. Joseph's Hospital, Kansas City, after a brief illness, aged sixty-five years. Mr. Strafer was born in Cincinnati and received his education at the University of Cincinnati. He started work in 1897 with the Bullock Electric Mfg. Co., of Norwood, Ohio, which was acquired by Allis-Chalmers in 1904. In 1907, he was transferred to the Kansas City office of the company, subsequently becoming its manager. Mr. Strafer was a member of the Engineers Club and the Electric Association, both of Kansas City. He is survived by his wife and two sons.

J. S. MARLOWE, district representative for the Jessop Steel Co. in Indianapolis, Ind., died November 2 at Indianapolis from a cerebral hemorrhage, aged sixty years. Mr. Marlowe had sold steel and steel products in the Indianapolis district for thirty-five years, during the last twenty of which he represented the Jessop Steel Co. He was a member of the American Society for Metals, and was a veteran of the Spanish-American War, which he joined at the age of seventeen.

* * *

New Molding Process for Plastics

A new process in the field of plastic molding has been developed by Walco Plastics, 356 Glenwood Ave., East Orange, N. J. By the Walco process, sheets of thermoplastic materials, such as cellulose acetate, are molded in a single operation into such intricate shapes as radio cabinets, fluorescent lighting fixtures, transparent acetate boxes, and a wide variety of articles having compound curves and angles. In the past, these articles have been produced from plastics by injection and compression molding methods, utilizing molding powders and relatively costly dies. The new process is said to require only low-cost dies, and will, therefore make small, as well as large, production runs economical.

During November, the shipments of aircraft engines from the plant of the Pratt & Whitney Division of the United Aircraft Corporation, East Hartford, Conn., totaled 2,000,000 H.P.—sufficient horsepower for more than 800 twin-engine bombers. The illustration shows some of the 450-H.P. and 2000-H.P. engines on the final assembly floor of the plant

SAVE TOOLS..TIME..MATERIAL *with* SUNOCO

PERFORMANCE DATA

OPERATION—Combined drilling and facing.

MACHINE—Jones & Lamson 7A Saddle Type Universal Turret Lathe.

CUTTING LUBRICANT—1 part Sunoco to 15 parts water.

Photo Courtesy of
JONES & LAMSON MACHINE CO.

SET A HIGH P-Q* FOR YOUR PLANT

Here's how to make a triple saving in your shop . . . and pave the way to a higher P-Q*(Production Quota). Put Sunoco Emulsifying Cutting Oil on the job!

SAVE TOOLS! Sunoco's high heat-absorbing and lubricating qualities prolong tool life . . . help keep tools sharper, longer. That's important today with high speed tool steel hard to get.

SAVE TIME! Today's production schedules demand speed. Again Sunoco proves your ally! A flood of Sunoco over tools and work permits heavy cuts at high speeds . . . faster production . . . increased output per unit.

SAVE MATERIAL! Sunoco users report savings in materials due to decreasing rejects caused by inaccuracies and faulty finishes. Sunoco puts "nth" degree accuracy on a production basis.

TEST SUNOCO in your own plant . . . under your own operating conditions. Call in a Sun "Doctor of Industry" for specific recommendations. It's the first step toward setting a higher P-Q*. Write to SUN OIL COMPANY, Philadelphia.

**Production Quota*

SUNOCO
EMULSIFYING
CUTTING OIL

SUNOCO

SUN PETROLEUM PRODUCTS HELPING INDUSTRY HELP AMERICA

NEW BOOKS AND PUBLICATIONS

COLLECTIVE WAGE DETERMINATION. By Z. Clark Dickinson. 640 pages, 6 by 9 inches. Published by the Ronald Press Co., 15 E. 26th St., New York City. Price, $5.

This book is a particularly timely one, in view of the fact that wage determination and bargaining principles constitute one of the most difficult problems confronting industry and government today. It covers, in considerable detail, the problems and principles incident to bargaining, arbitration, and legislation, special emphasis being laid on the economic and social relationships involved. The author is professor of economics at the University of Michigan, and the book represents the culmination of a study that has extended over many years.

Mr. Dickinson discusses the subject under five principal headings, dealing with a general survey of collective wage determination; factors commonly invoked in collective wage adjustment; wages and industrial fluctuations; wage policies and practices in private collective bargaining; and influences of public policy on wages. The discussion includes such important considerations as the cost of living in relation to wages; wages as a factor in production costs; wage-paying capacity and profit-sharing; cyclical employment; problems of the closed shop and "check-off"; regulation of wages by public authority; economic effect of state wage controls; and wage policy in war and in peace.

SHOP MANAGEMENT FOR THE SHOP SUPERVISOR. By Ralph C. Davis. 333 pages, 5 1/2 by 8 inches. Published by Harper & Brothers, 49 E. 33rd St., New York City. Price, $2.50.

At this time, when industry is straining every resource to meet the steadily expanding demands for defense materials, the publication of a volume on management is of especial importance. The proper planning, organizing and controlling of industrial production is vital to the successful achievement of defense objectives. This book is concerned with the problems confronting the shop supervisor in all phases of production control. It should be of value both to those already working in this capacity and to those who are taking supervisory training courses.

The material is divided into twelve chapters treating of the following subjects: Management and the Industrial Organization; Plant and Equipment; Production Control; Control of Job-Shop Production; the Foreman's Responsibility for Production Control; Production Control in Mass-Production Shops; Quality Control; Motion and Time Study; Plant Maintenance; Materials Control; Stores and Salvage; and Labor Management and the Shop Supervisor.

AMERICAN INDUSTRY IN THE WAR. Edited by Richard H. Hippelheuser. 498 pages, 6 by 9 inches. Published by Prentice-Hall, Inc., 70 Fifth Ave., New York City. Price, $5.

This book contains a report of the War Industries Board that was active in the first World War, the report having been made in March, 1921, by Bernard M. Baruch, chairman of the board. The book includes Mr. Baruch's own program for total mobilization of the nation, as presented to the War Policies Commission in 1931. There is also an appendix giving current information on priorities and price fixing.

Briefly, the book is divided into two sections: Section I entitled "American Industry in the War" deals with methods applied in the first World War; Section II, entitled "Taking the Profit Out of War" contains suggested policies to provide, without change in our constitutional guarantees, for industrial mobilization, elimination of profiteering, and equalization of the burdens of war. This section also deals with priorities. For those interested in the details of the procedure in the first World War, this book contains a wealth of information.

A.S.M.E. MECHANICAL CATALOG AND DIRECTORY (1942). 537 pages, 8 1/2 by 11 1/2 inches. Published by the American Society of Mechanical Engineers, 29 W. 39th St., New York City.

This is the 1942 edition of a volume containing condensed catalogue data and a directory of industrial equipment and supplies. The book is intended to provide the mechanical engineer with a list of the available sources for machines, equipment, and materials. The catalogue section is compiled by the manufacturers themselves, and contains condensed material consisting of specification data, application data, and illustrations. It contains descriptions of about 1600 items used by industry in manufacturing its products and maintaining its plants. The directory section contains an alphabetical list of all the products represented in the catalogue section, including name and address of manufacturers. There is also a trade-name section containing an alphabetical list of the trade names of many of the products. The volume is thoroughly indexed and cross-indexed.

ENGINEERING TOOLS AND PROCESSES. By Herman C. Hesse. 627 pages, 6 by 9 inches. Published by the D. Van Nostrand Co., Inc., 250 Fourth Ave., New York City. Price, $4.50.

The text of this book has been developed to serve as a brief lecture or reading course in engineering shop processes and practices. The first three chapters offer a survey of basic materials, elements, and devices to acquaint the students with engineering nomenclature and terminology. The book then takes up the usual shop processes and machines—from casting and forging through sheet-metal working and machining to finishing and welding. Then follow discussions of production machinery and methods not ordinarily presented in college laboratories, and the application of these methods to the manufacture of specific parts. The work concludes with a discussion of important considerations in design and the manner in which they affect production economy and feasibility.

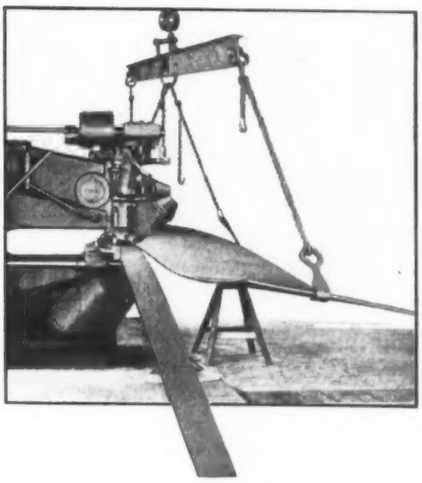
EYE HAZARDS IN INDUSTRY. By Louis Resnick. 321 pages. Published by the Columbia University Press, 2960 Broadway, New York City, for the National Society for the Prevention of Blindness. Price, $3.50.

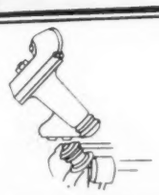
In view of the appalling number of preventable eye injuries that take place in industry each year — estimated to be more than 300,000—this handbook on eye hazards and their prevention should be of considerable value to industrial organizations, safety engineers and inspectors, and all those interested in accident prevention and sight conservation. Part I of the book, entitled "The Problem," discusses eye hazards, eye accidents, eye diseases, defective vision and first aid. Part II, entitled "The Solution," deals with mechanical guards, process revision, proper lighting, education, and administrative supervision.

BELT CONVEYORS AND BELT ELEVATORS. By Frederic V. Hetzel and Russell K. Albright. 439 pages, 6 by 9 inches. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York City. Price, $6.

This is the third edition of a book that has been the standard work on belt conveyors and elevators since its publication in 1922. It covers a general description of conveyors; the manufacture of belts; design of belt conveyors; loading the belt and discharg-

Don't Wait for a New Machine —USE YOUR QUICKWORK for Your SLITTING Jobs





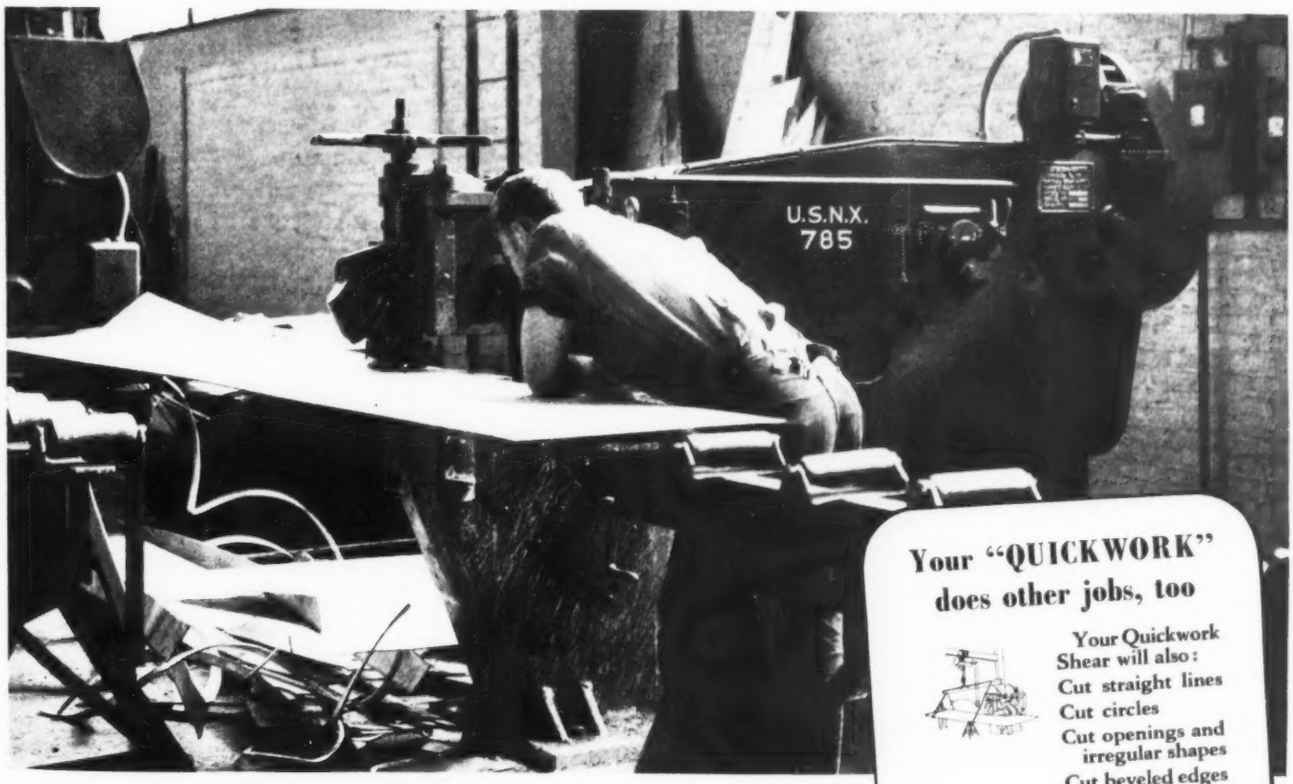
If you own a Quickwork-Whiting Rotary Shear, whatever its original use, you can quickly put it to use on any number of other jobs including slitting flat sheets.

For general shop work, your Quickwork with the Slitting and Flattening Attachment will slit any size sheet within the range of its capacity at the rate of 75 feet per minute. Strips are clean, without burrs. Scribed lines are unnecessary and a high degree of accuracy is maintained.

Save delay—investigate the Slitting Gauge and other special attachments that make the Quickwork-Whiting Rotary Shear the most versatile machine in any shop.

Above: Important feature of the Quickwork-Whiting Slitting Gauge is the flattening roll which prevents curl ordinarily given narrow strips when being cut from a sheet with rotary shears.

Below: Quickwork-Whiting Rotary Shear in service in the shops of the New York Ship Building Corporation. This is a No. 25-A Shear, capacity up to ¼" mild steel. Other models available to handle up to 1" mild steel.



Your "QUICKWORK" does other jobs, too

Your Quickwork Shear will also:

Cut straight lines
Cut circles
Cut openings and irregular shapes
Cut beveled edges
Flange and joggle
Make clean cuts without burrs—in a single pass at high speeds.

Don't wait for a new machine. Use your Quickwork.

"QUICKWORK" WHITING

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ing; protecting and cleaning; weighing and separating; package conveyors; particular uses of belt conveyors; life of belts; and when to use belt conveyors. The section on belt elevators contains a general description, followed by detailed descriptions of the various types and their use.

HOW AIR-CONDITIONING BUILDS BUSINESS PROFITS. 53 pages, 8 1/2 by 11 inches. Distributed by Airtemp Division, Chrysler Corporation, Dayton, Ohio.

This booklet contains a complete report of the first round-table clinic on air-conditioning sponsored by the Airtemp Division of the Chrysler Corporation, which brought together more than fifty vocational, professional, and business editors who reported on the applications and benefits of air-conditioning in their respective fields.

PERSONNEL AND INDUSTRIAL RELATIONS PROBLEMS IN THE DEFENSE PROGRAM. Proceedings of the Personnel and Industrial Relations Institute held at Purdue University May 15 and 16, 1941. Published as Extension Series No. 51 of the Engineering Extension Department, Purdue University, Lafayette, Ind.

PRICE AND PRIORITY DIGEST. Status of nearly 200 commodities and commodity groups under government and voluntary priority and price control. Published by the New York Journal of Commerce, 63 Park Row, New York City. Price, 10 cents.

METALLURGY. By Robert S. Williams. A vocational and professional monograph of 12 pages. Published by the Bellman Publishing Co., Inc., 6 Park St., Boston, Mass. Price, 50 cents.

COMING EVENTS

JANUARY 12-16—Annual meeting of the SOCIETY OF AUTOMOTIVE ENGINEERS at the Book Cadillac Hotel, Detroit, Mich. John A. C. Warner, secretary and general manager, 29 W. 39th St., New York City.

FEBRUARY 4-6—INDUSTRIAL RELATIONS AND PERSONNEL CONFERENCE sponsored by the American Management Association at the Hotel Stevens, Chicago, Ill. For further information, address the American Management Association, 330 W. 42nd St., New York City.

FEBRUARY 16-20—Mid-winter meeting of the NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION in Chicago, Ill.

MARCH 2-6—Spring meeting and Committee Conferences of the AMERICAN SOCIETY FOR TESTING MATERIALS at the Hotel Cleveland, Cleveland, Ohio. C. L. Warwick, secretary-treasurer, 260 S. Broad St., Philadelphia, Pa.

MARCH 12-14—Annual meeting of the AMERICAN SOCIETY OF TOOL ENGINEERS in St. Louis, Mo. Clyde L. Hause, secretary, 2567 W. Grand Blvd., Detroit, Mich.

MARCH 17-19—Annual convention of the AMERICAN RAILWAY ENGINEERING ASSOCIATION at the Palmer House, Chicago, Ill.

MARCH 23-25—Spring meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS in Houston, Tex. Secretary, C. E. Davies, 29 W. 39th St., New York.

MAY 31-JUNE 5—Semi-annual meeting of the SOCIETY OF AUTOMOTIVE ENGINEERS at the Greenbrier Hotel, White Sulphur Springs, W. Va. John A. C. Warner, secretary, 29 W. 39th St., New York City.

JUNE 8-10—Semi-annual meeting of AMERICAN SOCIETY OF MECHANICAL ENGINEERS in Cleveland, Ohio. Secretary, C. E. Davies, 29 W. 39th St., New York City.

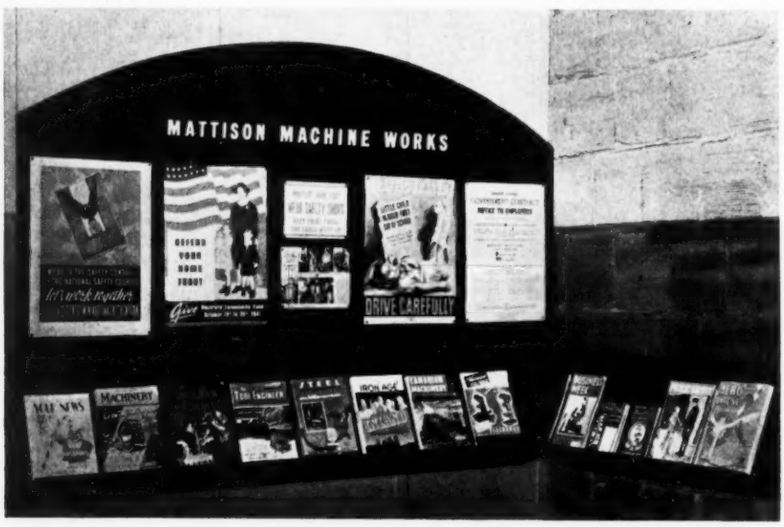
JUNE 22-26—Forty-fifth annual meeting of the AMERICAN SOCIETY FOR TESTING MATERIALS at the Chalfonte-Haddon Hall, Atlantic City, N. J. C. L. Warwick, secretary-treasurer, 260 S. Broad St., Philadelphia, Pa.

OCTOBER 12-16 — NATIONAL METAL CONGRESS AND EXPOSITION in Detroit, Mich., sponsored by the American Society for Metals. W. H. Eisenman, secretary, 7391 Euclid Ave., Cleveland.

* * *

Movie Film for Training Heat-Treaters

A sound and color movie film, "Heat-Treating Hints," has been prepared by the Lindberg Steel Treating Co., 2450 W. Hubbard St., Chicago, Ill. This movie requires approximately forty minutes to show. It is available for training and educational purposes. Among the subjects treated are straightening methods—hand and mechanical press straightening, torch spotting, straightening from the quench, and draw straightening; tongs and tools; hints on how to avoid distortion in handling high-speed steel; suggestions for quenching, etc. All the actors are real heat-treaters, and the movie shows them at their furnaces, quench tanks, etc.



Copies of a number of technical publications relating to the machinery industry are made available to the employes of the Mattison Machine Works, Rockford, Ill., by being placed on a magazine rack, as shown in the illustration. The rack is conveniently located in the shop, and the employes are encouraged to read these technical journals. The men read the magazines sometimes before starting to work, during the noon hour, or between shifts. The upper part of the magazine rack is used as a bulletin board

DESIGN, CONSTRUCTION, OPERATION OF METAL-WORKING AND ALLIED EQUIPMENT

MACHINERY

FEBRUARY, 1942

How a concern that builds printing presses in times of peace has turned to the production of naval gun mounts, as it did in the first world war, will be described in the leading article in March MACHINERY. Another article of broad general interest will deal with the maintenance of hydraulic systems applied to the operation of machine tools and other shop equipment. A series of articles on what a product designer should know about plastics will also begin in the March number.

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